A STUDY OF DAIRY FARM ORGANIZATION IN SOUTHEASTERN MINNESOTA

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CORNELL UNIVERSITY FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

BY

GEORGE A. POND

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A STUDY OF DAIRY FARM ORGANIZATION IN SOUTHEASTERN MINNESOTA

By George A. Pond

INTRODUCTION

The dairy enterprise is now the largest single source of farm income in Minnesota. It has grown steadily in size and in relative importance since the settlement of the state. The number of dairy cows has increased 50 per cent in the last decade and 16 per cent during the period of this study. Dairying is dominant on more Minnesota farms than any other enterprise. Because of the importance of dairying in Minnesota agriculture and because of the changes in cropping systems and livestock organization that must be made to accommodate this expanding industry, a detailed study has been made of the organization and operation of a group of representative dairy farms in Steele County. Complete records of labor and material utilized for all crop and livestock production, as well as full information on all other details of the farm business, have been secured to serve as a basis for judging the relative desirability of different combinations and adjustments of enterprises for conditions that might be encountered in the area, and for studying efficient methods of conducting the enterprises in these combinations. The complete cost route method[1] was used in this study. A five-year period, beginning January 1, 1920, is included. The records were kept by the farmers whose business was studied, with the help and supervision of a route man employed co-operatively by the Minnesota Agricultural Experiment Station and the Bureau of Agricultural Economics of the United States Department of Agriculture.

Acknowledgments

This study was conducted co-operatively by the Division of Farm Management, Agronomy, and Plant Genetics of the Minnesota Agricultural Experiment Station and the Division of Farm Management and Costs of the Bureau of Agricultural Economics, United States Department of Agriculture. The author wishes to acknowledge the assistance received from the chiefs and staffs of these divisions in organizing and developing this study and in reviewing and criticising the manuscript. Special credit is due Andrew T. Hoverstad, of the Division of Farm Management, Agronomy, and Plant Genetics, for his assistance in collecting and tabulating the data and preparing them

[1] For the description of this method see Minn. Agr. Exp. Sta. Bul. 205, by G. A. Pond and J. W. Tapp; also issued as U. S. D. A. Bul. 1271. 1923.

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PART I. HISTORY AND DESCRIPTION OF THE AGRICULTURE OF THE AREA

Location and Description of the Area

Location

The farms studied are located in Steele County, near Owatonna, the county seat. This city had a population of 7252 in 1920. It is the principal marketing and business center of the county. Steele County is fairly representative of most of the dairy section of southeastern Minnesota in soil, climate, markets, and other conditions affecting the dairy industry. In this general area dairying is more widely practiced, the enterprise is more intensively conducted, and the type of farming is more uniform than in any other part of the state.

Climate

No data are available on climatic conditions in Steele County. In Table I are presented data on weather conditions for the five years of this study and for the ten-year period, 1915-24, from records kept at Waseca, fourteen miles west of Owatonna. Climatic conditions are fairly uniform over this section of the state. The monthly distribution of rainfall is indicated in Figure 2. Both amount and distribution vary considerably from year to year, but 75 per cent of the total precipitation occurs during the growing season. The first four years of the study were marked by less than normal rainfall. This resulted in short pastures and light second cuttings of hay and caused many new seedings of grass to fail. However, the deficiency

was least during the months when most of the field operations were performed, hence did not materially affect labor accomplishments.

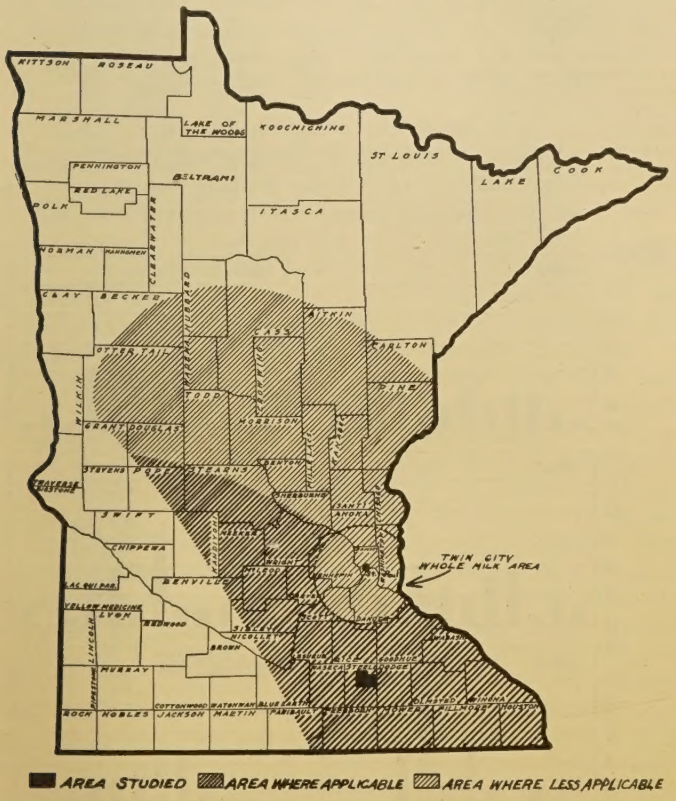

Fig. 1. Location of Area Studied

The type of dairy farming in Steele County is common to most of southeastern and east central Minnesota.

In 1923 corn and hay yields were greatly reduced by the drouth. The early part of 1924 was very dry and cool, and crops, especially pastures, started slowly. Abundant rainfall later resulted in fair hay yields and a very heavy small grain crop. The cool weather so delayed the corn crop that much of it failed to mature.

TABLE I

CLIMATIC CONDITIONS AT WASECA, 1915-1924

	1920	1921	1922	1923	1924	10-year average
Maximum temperature	96	101	100	99	93	96
Minimum temperature	—22	—14	—22	—28	—37	—28
Mean annual temperature	44.7	48.1	46.5	45.8	42.7	43.9
Mean temperature April 1–Sept. 30.	61.6	65.8	64.4	63.6	59.0	61.6
Precipitation April 1–Sept. 30	12.25	20.74	15.24	16.68	27.73	21.44
Precipitation Oct. 1–March 31	8.31	3.64	8.78	5.46	5.81	7.30
Precipitation, total annual	20.56	24.38	24.02	22.14	33.54	28.74
Last killing frost in spring	Apr. 28	May 16	Apr. 22	May 17	May 25	May 11
First killing frost in fall	Sept. 30	Oct. 3	Oct. 9	Oct. 13	Sept. 30	Sept. 26
Frost-free days	154	139	169	148	127	137

* U.S. Weather Bureau, Minnesota Section.

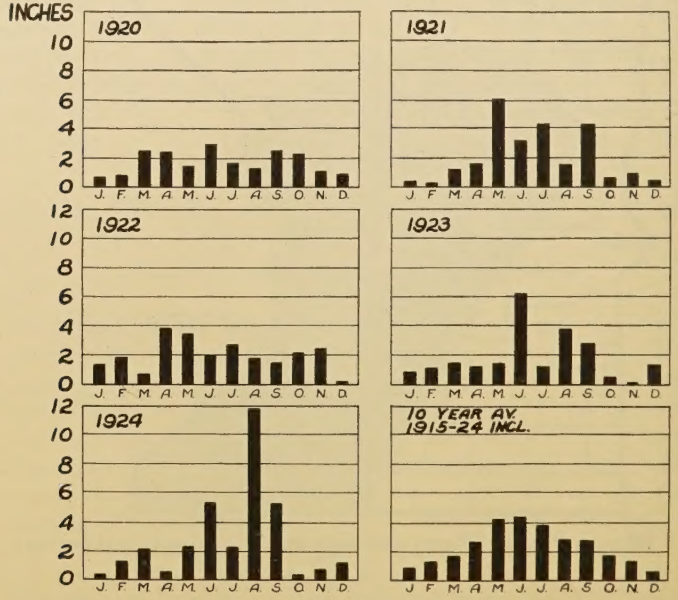

Fig. 2. Monthly Precipitation at Waseca, 1920-24 and 10-Year Average

The distribution of rainfall varies widely from year to year but most of the precipitation occurs during the growing season.

Soil and Topography

A rich black clay-loam soil with pebbly clay subsoil predominates in Steele County, as in all of southern Minnesota west of Steele County. There are also small areas of outwash sand and gravel along the streams. Most Steele County soils are well supplied with lime, but to the east of the county lies a large area of Old Gray Drift and loess, the surface soil of which is quite deficient in lime.

Steele county is level to gently rolling, with some steep hillsides along the water courses. The rolling land is naturally fairly well drained, but much of the level land is tiled to make possible its cultivation in wet years. The southern part of the county is open prairie, but the northern part and the river valleys were originally covered with heavy timber. Some good sized farm woodlots still remain. Most of this southeast dairy section was originally wooded.

Transportation and Markets

Steele County has excellent transportation facilities. The Chicago, Milwaukee, & St. Paul and the Chicago, Rock Island, & Pacific railroads furnish service to the north and south; and the Chicago & North Western to the east and west. Well improved state and federal highways, either graveled or paved, cross the county in both directions and are kept open throughout the year. County and township roads are dragged and in many cases graveled, so that most farms have access to markets by auto or truck during the greater part of the year.

Cream is the principal product marketed from these farms and is sold to co-operative creameries which specialize in the manufacture of high quality butter. The first co-operative creamery in the state was organized in 1890, a few miles south of the Steele County line. The movement developed rapidly and similar creameries were organized throughout this area. The twenty-three co-operative creameries in the county now absorb practically its entire dairy production. Except in the market-milk area around the Twin Cities, and in a cheese factory district in Dodge, Goodhue, and Olmstead counties, where about 25 per cent of the total milk is manufactured into cheese, practically the entire dairy product of this southeast dairy district and the central district as well, is marketed as cream through co-operative creameries. These creameries are federated into a large central marketing organization which sells their butter for them. Because of their more efficient organization and the high quality of their butter, these creameries pay higher prices for butterfat than the average creameries of the state. For the last fifteen years, according to the report of the State Dairy and Food Commission, Steele county creameries have paid farmers 8 per cent more for butterfat than the average price paid throughout the state.

There are four farmers' co-operative elevators and eight co-operative livestock shipping associations in Steele County. The latter handle practically all the stock shipped out of the county for slaughter. A co-operative poultry and egg marketing association, organized in 1924, is now serving the county. Because of their well organized marketing

facilities, farmers of Steele County and this southeast dairy section receive relatively better prices for their principal products than producers in other sections of the state.

Settlement and Agricultural Development of Steele County

History of Settlement

The settlement and development of Steele County is fairly typical of the entire dairy section of southeastern Minnesota. This was the first section of the state to be settled. The earliest settlers came in 1853, and the county was created and organized in 1855. The 1860 census reports 330 farms and a total population of 2863 (Table II). Railroads reached the county from the south and east in 1866. A period of rapid agricultural development followed. By 1880 practically all the land now in farms was in use. There has been some increase in the number of farms since that time with increases also in farm population, total acreage in farms, and percentage of improved land in farms.

TABLE II

NUMBER OF FARMS, LAND IN FARMS, VALUE OF LAND AND BUILDINGS PER ACRE, AND POPULATION OF STEELE COUNTY, 1860-1925*

Year	Farms in county	Acreage in farms	Average acreage per farm	Improved acreage per farm	Value of land and buildings per acre	Population
1860	330	57,911	176	29	$ 5.74	2,863
1870	831	118,377	143	57	16.68	8,271
1880	1607	243,362	151	120	18.96	12.460
1890	1590	236,988	149	134	18.58	13,232
1900	1801	263,371	146	126	42.62	16,524
1910	1824	262,555	144	123	60.98	16,146
1920	1860	259,215	139	115	137.05	18,061
1925	1997	264,061	132	...	108.53	.....

* U.S. Census data.

Changes in Acreage of Important Crops

Changes in the relative importance of the principal crops grown in Steele County since 1859 are shown in Figure 3. During the first years following settlement the few improved acres were devoted largely to feed crops. As the improved acreage increased and transportation and markets were developed, wheat increased rapidly in importance. By 1879 more than half the crop acreage was devoted to it. Up to this time new land was rapidly being brought under cultivation; since then there has been little expansion of the cultivated area. Continuous cropping with wheat led to decreased yields. Insect pests and diseases increased rapidly. The chinch bug was particularly destructive from 1885 to 1890. More diversification became necessary. The amount of livestock per farm, which had remained practically constant since 1860, more than doubled between 1880 and 1890. Feed crops replaced wheat. By 1889 the percentage of crop land in wheat dropped to 24.

Better yields of wheat followed this shift, and some reaction took place. The rate of livestock expansion decreased, and by 1899 nearly 39 per cent of the crop acreage was in wheat. Since that time livestock has steadily increased and wheat has been displaced by feed crops. Increasing damage by black stem rust is a factor of some importance in reducing the wheat acreage.

Corn and oats are the principal feed grains of the area, and their increase has followed fairly closely the expansion of the livestock industry. Barley, tho grown in part for sale during the earlier years, is now exclusively a feed crop. Hay has always occupied a large acreage. In the earlier years this was largely native grass and the yield was rather light. Often large areas were left uncut. As the livestock industry developed, the planting of higher yielding cultivated grasses and legumes enabled a smaller acreage of hay to support more livestock. The corn crop has also supplemented hay as a source of roughage. In 1924, 27 per cent of the corn crop was cut for fodder and 20 per cent was put into silos.

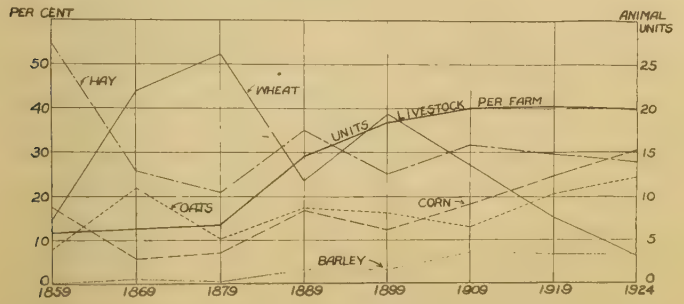

Fig. 3. Percentage of Crop Acreage Devoted to Principal Crops and Units of Productive Livestock in Steele County, 1859-1924

Wheat was once the leading crop in the county. With the shift to dairying it has steadily been replaced by feed crops.

In addition to the crops shown in Figure 3, small acreages of flax, rye, buckwheat, and potatoes have been grown. In recent years, peas and corn for canning have been grown to a limited extent, and in the last two years considerable acreages of sugar beets have been introduced on a few farms. The total acreage devoted to these miscellaneous crops has never exceeded 4 per cent of the total crop area.

The trends in crop production in Steele County are fairly typical of the southeast dairy section. In 1879 approximately 70 per cent of the wheat acreage in Minnesota was in this section. In 1924 scarcely more than 25 per cent of the acreage was included. The acreage was

less than one-fifth that of the earlier date. The shift was slightly more pronounced in Steele County because of the greater intensity of livestock production.

Changes in Number and Kind of Livestock

The trend of livestock expansion in Steele County is shown in Figure 4. As indicated in Figure 3, there was little change in the amount of livestock per farm up to 1880, when the definite shift from grain to livestock farming began. Before this time the stock was kept primarily to supply home needs. The amount of livestock per farm more than doubled during the next decade, and there has been a steady increase since.

The first cattle brought to Steele County were of beef or "dual purpose" breeding. Enough cows were milked to supply the home with dairy products, and any surplus butter made was sold or exchanged for groceries or other supplies. The calves were raised, and those not needed to maintain the herds were sold for beef. The first

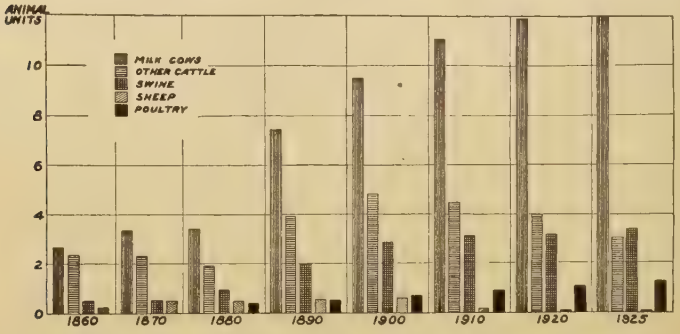

Fig. 4. Animal Units of Productive Livestock per Farm in Steele County, 1860-1925

The shift from grain to livestock farming started during the eighties. Since 1880 milk cows, swine, and poultry have increased steadily. Increased dairy specialization has resulted in a decrease in the number of other cattle and of sheep since 1900.

dairy product to be commercially manufactured was cheese. In 1872 there were six cheese factories in the county. Their output was small and by 1885 the number was decreased to three. These continued to operate until replaced by creameries in the nineties. In 1891 four creameries in the county were manufacturing butter. The number increased to nine the following year and to seventeen by 1894. With the coming of the creamery more attention was paid to breeding cattle for dairy production. The first cattle of specialized dairy breeds were brought to the county about 1880. It was not until after 1900, however, that the real shift to specialized dairying started. Co-operative creameries were affording a profitable outlet for dairy products and

there was a steady increase in both number of cows and intensiveness of dairy breeding. With the shift to the specialized dairy breeds, fewer calves were raised, as the dairy breeds produce beef of inferior quality. In 1900 there was one head of other cattle to each cow, but in 1925 there is only one head to 2 cows. Enough young stock is raised to maintain the herds, with some to sell as breeding stock. Cattle sold for meat are largely either veal calves or unprofitable cows culled out of the dairy herds.

The trend in swine production has followed the dairy enterprise quite closely. Hogs are to a considerable extent a by-product enterprise in a creamery district, utilizing the skimmilk left after the cream has been separated and sold. Large quantities of skimmilk for small pigs give the dairy farmer a decided advantage in pork production.

Sheep have never held a prominent place on Steele County farms. There have been small farm flocks, but with the expansion of the dairy industry the number has steadily declined.

Poultry has increased steadily since the first report, in 1880. Altho still a minor enterprise on most farms, there is an increasing tendency toward specialized poultry production. Like swine, poultry fit in well with the dairy enterprise and can use skimmilk advantageously.

Present Type of Farming

Size and Description of Farms

Thirty-eight farms are included in this study. Records were obtained from 12 farms for one year, from 5 for two years, from 5 for three years, from 6 for four years, and from 10 for five years—a total of 111 farm record years. The average size of farm was 186 acres, with a county average of 139 acres. One hundred twenty-nine acres were in crops; 47 in pasture; 7 in farmstead, roads, and lanes; and 3 in waste. Of the pasture, about a third is rotation pasture on land that has been cropped, the balance is rough or wooded land or land not sufficiently drained for regular cropping. Seventy-two per cent of this land is operated by owners and the rest by tenants.

No changes in ownership occurred during the period of this study except transfers from father to son. A relatively high percentage of ownership and greater stability of tenure characterize the dairy sections of the state. The average distribution of cash receipts from these farms during the period studied was cattle 52 per cent, swine 29 per cent, other livestock 6 per cent, crops 11 per cent, and miscellaneous 2 per cent.

Cropping Systems and Rotations

Feed crops predominate in Steele County. The relative importance of the crops grown on the farms studied and a comparison with the county as a whole are shown in Table III.

TABLE III

DISTRIBUTION OF CROP ACREAGE ON FARMS STUDIED AND ON ALL FARMS IN STEELE COUNTY

Crop	Farms studied*						All farms†
	Total acreage	No. of farms growing the crop	Acreage on farms growing the crop			Per cent of total crop acreages	Per cent of total crop acreages
			Average	Maximum	Minimum		
Corn	4682	111	42	93	17	32.7	29.1
Oats	3358	111	30	85	7	23.4	22.7
Tame hay ...	1780	103	17	47	1	12.4	12.9
Barley	1507	97	16	71	3	10.5	5.6
Wild hay ...	997	82	12	46	1	7.0	14.9
Wheat	813	63	13	42	1	5.7	9.6
Alfalfa	412	63	7	20	1	2.9	0.3
Sugar beets .	164	8	21	39	11	1.2	0.1
Flax	130	14	9	25	3	0.9	1.2
Miscellaneous.	479	106	5	27	1	3.3	3.6

* Average for 111 farm years, 1920-24 inclusive.

† Average for all farms in Steele County, 1920-24 inclusive.

The only crops grown primarily for sale are wheat, flax, sugar beets, and peas and corn for canning. Sugar beets have been grown only in 1923 and 1924 on the farms studied. The only recent changes in the cropping system are the introduction of sugar beets on a few farms and the rapid increase of the alfalfa acreage from 1 per cent of the total crop acreage in 1920 to 5.4 per cent in 1924.

No definite rotation system is practiced. About eleven acres of meadow and pasture per farm are broken each year and planted to corn. Of the rest of the corn, three-fourths follows small grain and one-fourth follows corn. Of the small grain, about two-thirds follows corn and one-third small grain. About half the small grain is grown in mixtures. Oats and barley is the most common mixture but oats is also grown with wheat. The latter mixture is commonly called succotash. These mixtures are fed without separating except when the price of wheat is high, then the wheat is often separated from the oats and sold.

Description of Livestock

The number and kind of livestock on the farms studied are shown in Table IV. The intensity of stocking on these farms and on the average farm in the county are compared. The farms studied are evidently more heavily stocked than the average. The larger number of young cattle as compared with cows on these farms is probably due in part to differences in classifying the two groups. These are largely high grade or purebred cattle of dairy breeding. Approximately one-third are registered purebreds. This fact may also account for the larger proportion of young cattle, as more breeding stock is raised in the purebred and high-grade herds. On one farm a few breeding cattle of beef breed were maintained. On two others, feeders were purchased and fed. Otherwise all cattle were of dairy breeding.

Most of the swine are kept for pork production, altho several excellent purebred herds are included from which considerable breeding stock is sold. A few small flocks of sheep are maintained. The poultry enterprise, tho a minor one on most farms, is being rapidly expanded. The flocks averaged 40 per cent larger in 1924 than in 1920. Horses are the principal source of motive power on these farms, altho tractors, also, are used on more than half. On one farm purebred draft horses were kept and considerable attention was paid to horse breeding, but on most farms only enough colts were raised to supply the needed work stock.

TABLE IV
LIVESTOCK ON FARMS STUDIED AND ON ALL FARMS IN STEELE COUNTY

Kind of stock	Farms studied					Average number per 100 acres	
	Farms reporting	No. of head	No. head on farms reporting			Farms studied	All farms
			Average	Maximum	Minimum		
Milk cows	111	1851	16.7	29	5	9.0	10.3
Other cattle	111	2033	18.3	47	1	9.8	4.4
Swine	111	4837	43.6	185	1	23.4	13.5
Poultry	111	16381	147.6	325	50	79.4	78.9
Sheep	16	158	9.9	34	4	0.8	0.6
Work horses	111	741	6.7	14	3	3.6	3.6
Colts	51	122	2.4	7	1	0.6	0.5

PART II. UNIT EXPENDITURES OF LABOR AND MATERIALS FOR LIVESTOCK, CROP, AND MISCELLANEOUS WORK

Expenditures of Labor and Materials for Livestock

The principal requirements for livestock production are feed, man labor, and horse labor. In addition to these, which can be measured in physical units, are such others as medicine, veterinary services, disinfectants, etc., that can be measured only in money values. The amounts used for each class of stock on the farms studied are shown on the per head basis except in case of swine and poultry. Labor and materials for swine production are presented on the basis of the amounts used to produce 100 pounds net gain in weight. One hundred birds is the unit for poultry. Except in case of young dairy cattle, the product of each class of stock is indicated in terms of physical units. Where joint production is involved, both products are given. As growing dairy stock are valued on the basis of pedigree and conformation rather than size, no attempt has been made to measure their production on a weight basis.

The amount of roughage fed to livestock does not include straw for either feed or bedding, altho it was used for all classes of stock for the latter purpose and for feed for horses and, to some extent, for

cattle. It was impossible to get an accurate measure of the amount used. Several classes of stock usually eat at will from the same stack. Often more is tramped under foot than is actually eaten. Even where fed in mangers, much is thrown out as bedding. Altho no record of amounts used is available, it should be kept in mind that practically all straw grown on these farms was either used for bedding or fed to stock. In using these data, allowance should be made accordingly.

In addition to showing the amounts used for each class of stock on each farm for one year and the average of all farms for each of the five years, standards for each class of stock are presented. The standards are based on the accomplishments of farmers ranking approximately in the upper 25 per cent in efficiency of production. They represent the attainments of the farmers who are practicing the most profitable methods in feeding and handling their stock. This standard is materially better than the average on the farms studied, yet it is easily within the reach of any farmer who follows the practices discussed in this section of the study.

Dairy Cows

Description of Enterprise

The cows included in this study are all of dairy breeding. There are two Ayrshire herds, one Jersey herd, and one Guernsey herd. The rest are practically all of Holstein breeding. A third of all these cows are purebred and the rest are largely high grades. They are maintained mainly for butterfat production, altho the sales of purebred bull calves and purebred and high grade heifer calves are a source of considerable income.

Most of these farmers raise their own cows. Of the additions to these herds during the five years, 89 per cent were heifers raised in the herd and 11 per cent were cows bought from other herds. The heifers freshened at from 24 to 30 months. The average milking life of a cow was about five years, altho some individuals, especially valuable purebreds, were kept as long as they continued to produce calves regularly. Each year an average of one cow in five was sold. The annual death loss was 2.1 per cent. Of the cows sold, half were sold for slaughter and half for use in other herds.

Winter dairying predominates on these farms. Sixty-one per cent of the calves are born in September, October, November, and December, and only 8 per cent in the preceding four months. The milk is separated on the farm, the cream is marketed, and the skimmilk is fed.

The amount of feed and labor used and the production per cow are shown in Table V. The expenditures for each herd are presented for 1924 but only averages for the other four years. The year 1924 was chosen because the most efficient production was obtained that

year. The labor includes not only the regular chores—milking, feeding, cleaning the barn, and bedding the cows—but also marketing cream and such occasional operations as caring for a sick cow or testing for tuberculosis. The production record is based on butterfat actually utilized. It includes butterfat sold as cream and butterfat in whole milk, cream, or butter used in the house, and whole milk fed to calves.

Variations in Amounts of Feed for Dairy Cows

The amount fed is varied by the farmer according to his judgment and the supply of feed available. In general, a cow is fed according to her milk production, as indicated in Table V, in which are included all the herds studied, with each herd year considered a unit. The grain and the roughage fed per cow increase as production increases. The amount of pasture used per cow is determined by the season and bears little relation to production. The feed used per pound of butterfat indicates some significant differences between the production groups. It is often assumed that the roughage in a dairy cow's ration largely provides for body maintenance and that the grain fed is primarily for production. In general, this table bears out this assumption. In all groups the grain fed bears an almost constant relation to butterfat production. The roughage fed, on the other hand, altho somewhat larger per cow for the higher producing cows is less per pound of butterfat as production increases. As the maintenance requirement is fairly constant regardless of the production, the higher producing cows are more efficient in converting feed into butterfat than the low producers. There are, however, exceptions to the general rule that cows are fed according to butterfat production. If there are a large number of heifers in the herd which have not yet come into full production and are still growing, as was the case on Farm 26, more feed, proportionately, must be fed. Nine heifers freshened in this herd in 1924 and 8 the previous year. On Farm 20 the feeds are high because a herd was put on the show circuit, and extra feeds were used to put it in show condition.

The price of feeds affects the amount to be fed. The light grain feeding in 1920 was partly due to the high price of grain in relation to the price of butterfat. By 1921 feed prices declined much more, relatively, than butterfat prices, and grain was fed more freely. The farmers using beet tops fed more succulent roughage per cow than those feeding corn silage alone. Beet tops had no market value and could not be stored conveniently for winter use. As a result they were fed so liberally that there was considerable waste. On Farm 31 silage was fed so liberally that much was wasted, but this was exceptional.

TABLE V

AMOUNTS OF FEEDS, LABOR, AND MATERIALS USED PER YEAR FOR A DAIRY COW, 1924

Farm No	No. of cows per farm	Corn	Small grain	Mill feeds	Oil-meal	Tame hay	Wild hay	Alfalfa	Corn fodder	Silage	Pasture	Total grain	Total dry roughage	Man labor	Horse work	Vet. services and medicine	Milk production	Butter fat production
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	days	lbs.	lbs.	hrs.	hrs.		lbs.	lbs.
5	24.1	...	1243	...	...	2358	...	471	...	5706	176	1243	2829	90	11	$0.70	4712	147
7	15.9	...	293	...	...	543	...	...	1122	10146	178	293	1666	97	3	0.49	4249	150
34	13.3	...	81	...	...	662	722	923	226	5509	221	81	2533	85	9	0.26	4986	182
14	18.2	...	757	...	16	300	...	1760	631	6868	189	773	2691	178	4	0.06	5805	184
25	25.5	...	722	39	...	...	883	262	1716	18284*	181	761	2861	174	3	...	5629	188
9	24.0	...	1408	...	...	...	...	2374	333	8957†	169	1408	2707	169	6	0.52	6058	189
24	13.3	179	1462	180	...	879	...	1061	...	13888‡	159	1821	1940	192	7	1.67	5736	191
10	15.6	260	1499	...	...	381	...	760	...	9128§	189	1759	1141	179	7	0.24	5244	194
26	23.8	...	2071	...	...	1843	...	210	...	6416	174	2071	2053	162	4	0.19	6012	196
35	17.4	...	843	86	...	302	...	886	...	9212	199	929	1188	146	7	0.86	5025	206
28	13.6	...	1757	...	15	853	...	631	2143	6208	176	1772	3627	197	7	1.31	6035	207
13	13.2	...	1030	19	...	1547	...	1021	1140	6145	171	1049	3708	129	9	...	6246	213
6	18.7	...	1748	243	112	1409	...	502	...	7434	161	2103	1910	132	8	1.42	6305	215
1	16.8	...	1207	388	18	553	...	3595	...	8220	173	1613	4147	148	7	0.53	6279	221
20	12.8	...	2633	127	39	97	...	2016	468	8539	189	2799	2581	258	22	...	6560	225
23	18.0	...	1494	...	...	1979	223	...	446	7527	160	1494	2648	156	4	...	6453	231
21	29.2	165	1901	264	...	1132	166	1381	...	8717	193	2330	2679	153	5	0.62	7533	232
19	13.4	...	1309	693	...	1930	...	...	1048	6768	160	2002	2978	172	10	0.22	7318	251
31	8.0	...	2629	...	40	1247	...	878	750	13979	161	2669	2875	233	16	0.45	7927	260
17	12.2	20	992	180	...	1515	...	...	316	15945‖	181	1192	1831	221	32	0.30	5338	269
18	20.0	...	1595	...	89	847	...	1471	...	9713	151	1684	2318	131	10	1.71	8074	285
Averages																		
367 cows,	1924	31	1356	101	15	971	111	982	452	9137	177	1503	2516	158	9	0.55	6038	208
370 "	1923	329	1563	69	17	1338	48	633	450	9297	196	1978	2469	155	10	0.97	6435	213
372 "	1922	595	1262	80	29	1874	237	598	368	7368	188	1966	3077	157	6	0.51	5873	195
308 "	1921	508	935	202	50	1523	71	238	143	8000	184	1695	1975	194	9	0.86	4912	174
337 "	1920	269	694	251	59	1870	62	...	283	7456	162	1273	2215	172	13	0.57	4873	170

* Including 11,435 pounds beet tops.
† Including 3808 pounds beet tops.
‡ Including 5817 pounds beet tops.
§ Including 4405 pounds beet tops.
‖ Including 5400 pounds beet tops.

The amount and quality of pasture materially affect the grain and roughage used. The number of days that the cattle are actually on pasture, tho the best available, is an inadequate measure of the amount of pasture consumed as compared with other feeds. The cows on Farm 34 were on pasture the largest number of days. They received no grain or silage and only a small amount of hay—they depended almost entirely on the pasture. On Farm 35, reporting the next largest number of pasture days per cow, the cows received silage in addition to the pasture except for one month. On Farm 20 the cows received grain all but two months while on pasture, as well as some hay and silage.

The herds on Farms 35 and 20 probably received less feed per day from the pasture than the herd on Farm 34. On the other hand, Farm 19 reports only 160 days of pasture, but during this time the cows received very little supplemental feed. This 160-day period represents more feed than the 199 days on Farm 35 or the 189 days on Farm 20.

The extent of supplemental feeding while the cows are on pasture is an important factor in determining the amount of feed used. While on winter feed the daily ration is fairly constant. The amount fed varies with the length of the feeding season and the amount of summer feeding. In 1920, when grain feeding was lightest, less than 9 per cent was fed while the stock was on pasture; but in 1923, the year of heaviest grain feeding, 29 per cent was fed during the pasture months. Pastures were best in 1920 and poorest in 1923. The heaviest dry roughage feeding was reported in 1922, 1923, and 1924, when 17 per cent was fed during the pasture months. Only 10 per cent was fed in 1920 and 1921.

TABLE VI

RELATION OF FEED AND LABOR EXPENDITURES TO PRODUCTION OF BUTTERFAT

Production group	No. of herds	Average production of butterfat	Feed and labor per cow				Feed and labor per lb. of butterfat			
			Grain	Dry roughage*	Pasture	Labor	Grain	Dry roughage*	Pasture	Labor
		lbs.	lbs.	lbs.	days	hrs.	lbs.	lbs.	days	hrs.
Under 160..	23	137	1197	4865	181	160	8.7	35.4	1.3	1.2
160-189	25	177	1508	4742	181	183	8.5	26.7	1.0	1.0
190-219	35	204	1828	5313	182	170	9.0	26.1	0.9	0.8
220 and over	23	251	2130	6283	177	185	8.5	25.0	0.7	0.7

* Three pounds of silage is considered the equivalent of 1 pound of dry roughage.

The effect on total feed of supplemental feeding while on pasture is also brought out by a study of individual farms. The amount of feed is almost invariably higher when considerable supplemental feeding is practiced. On Farms 7, 25, and 34, having the lowest grain requirements per cow, no grain was fed while the stock was on pasture. On Farms 20, 21, and 31, having the highest grain requirements per cow, 26.4 per cent was fed while the cows were on pasture.

On the three farms reporting the lowest feeding of dry roughage, only 1.3 per cent was fed during the pasture season; but on the three farms reporting the highest dry roughage feeding, 18 per cent was fed while the cows were on pasture. Corresponding figures for the three high and the low silage feeding groups were 4.6 and 31.4 per cent. These differences are due to differences in both amount and quality of pasture available and in intensity of production. Heavier feeding is practiced when pastures are poor or limited in size, and also when cows are being pushed for high production.

Variations in Labor Expenditures for Dairy Cows

Size of herd.—Herds above the average in size received 24 per cent less labor per cow than those below the average. Milking is the only operation that varies directly with the size of herd. For most other operations the labor per cow decreases as the number of cows increases.

Use of milking machine.—The average man labor expenditure on Farm 21 was 182 hours per cow for the four years before the milking machine was purchased, and 153 hours in 1924, when a machine was used. The average labor expenditure per cow on Farm 18 was 142 hours before and 130 hours after the purchase of a milking machine. In both cases the cows were fed more heavily after the machine was purchased and their production was materially increased. This indicates that the saving in labor resulted from the use of the machine rather than from less intensive methods of care or feeding.

Production of herd.—In general, the labor expenditure per cow tends to be higher for high producing herds, as they are not only fed heavier but they receive more feed in summer when on pasture. They receive more care and attention than low producing herds. When measured on the basis of labor per pound of butterfat, however, the labor expenditure decreases steadily as production increases. The production per cow increases more rapidly than the labor.

Fitting and showing cattle.—The heavy labor expenditure on Farm 20 is partly due to the fact that the herd was shown at several fairs. A large amount of extra labor was involved in fitting and showing.

Variations in Production of Butterfat

Amount and kind of feed.—The higher producing cows receive more feed, especially grain, than the low producers. The data in Table V indicate a fairly close and direct relation between grain fed and butterfat produced. The kind of feed is also important. For example, the herd on Farm 18 was fed 2314 pounds of grain and 6028 pounds of dry roughage per cow in 1923, as compared with 1684 pounds of grain and 5556 pounds of dry roughage in 1924. Yet in 1924, in

spite of lighter feeding, the production of butterfat per cow was 285 pounds as compared with 256 in 1923. This heavier production was largely due to the difference in quality of the rations fed. In 1923, 72 per cent of the roughage was timothy and clover, 21 per cent corn fodder, and 7 per cent alfalfa. In 1924, 37 per cent was timothy and clover and 63 per cent was alfalfa. The nutritive ratio of the roughage in 1923 was 1 : 11.7 as compared with 1 : 7.9 in 1924. As the grain ration was of about the same quality both years, the nutritive ratio of the total ration was 1 : 7.3 in 1924 as compared with 1 : 8.6 in 1923.

The same tendency for a ration with a narrower nutritive ratio to increase production is indicated in a comparison of the average figures for 1923 and 1924—480 pounds less grain per cow was fed in 1924 as compared with 1923 and the roughage remained the same. In spite of a 24 per cent cut in the grain ration, the production of butterfat declined only a little over 2 per cent. The nutritive ratio of the average 1923 ration was 1 : 8.5 and of the average 1924 ration 1 : 7.5. This narrowing of the ration was largely the result of the substitution of alfalfa for roughage less rich in protein.

Condition and health of herd.—The low production of the herd on Farm 5 was largely due to disease. The general condition of the herd was lowered and, owing to failure to breed, the cows did not freshen regularly.

Quality of cows.—The quality of the cows composing these herds is an important factor affecting production, but its effect is obscured by variations in feeding practices. On Farm 18, for example, is a very carefully selected herd of high quality that is also very carefully fed. This herd has been built up through the consistent use of pure-bred sires of high producing strains and the careful selection of the progeny. Heifers from the highest producing cows are added to the herd and only those maintaining a high standard of production are retained. In each year of this study, 25 per cent of the herd was weeded out and replaced by promising heifers. In four years the production was increased from an average of 202 pounds of butterfat per cow to 285 pounds. The increase in the average production from 170 pounds in 1920 to 213 pounds in 1923 is also due, in considerable measure, to improving the quality of the herds through breeding and selection. The slight drop in production in 1924 is due to a material reduction in grain feed. The production in proportion to feed was larger in 1924 than in any previous year, indicating a steady improvement in the quality of the herds.

Veterinary Service and Medicine

The cash expense for veterinary service and medicine varies widely from farm to farm and from year to year. The item includes mineral feed. It is large on Farms 6, 18, and 24 because of the larger amount of mineral feed used. This item also includes disinfectants and fees for tuberculosis testing.

Standards for Dairy Cows

The following are suggested as standards for a cow of good dairy breeding producing 250 pounds of butterfat per year. In computing the labor item it is assumed that the herd contains at least 15 cows and that reasonably convenient facilities are provided for feeding and handling the herd.

Grain, pounds	1900
Hay, alfalfa or clover, pounds	2500
Silage, pounds	9000
Pasture, days	160
Man labor, hours	150
Horse work, hours	10
Cash costs (veterinary care and medicine), cents	75

Distribution of Labor on Dairy Cows

Figure 5 shows the distribution of labor by weeks on a dairy herd averaging 20 cows for the year. The shaded portion of each bar represents the regular daily work—milking, separating the milk, feeding and bedding the cows, cleaning the barn, etc.—the clear portion, time spent marketing cream, such extra work as selling a cow or caring for a sick cow, and any other work on cows done at irregular intervals. This distribution is typical for the community for a well managed herd. These cows freshened in September, October, and November. They were kept in the barn until about April 1. From then until May 20 they were allowed to run in the yard during the day. Up to this time they were on full winter feed. On May 20 the cows were turned out to pasture and received no further feed until August, when silage feeding was resumed. In September grain feeding was begun and in October, hay feeding. The cows were taken off pasture at the end of October and put on full winter feed. The labor demand was lowest in August and September, when more than half the herd was dry. As the cows freshened, the amount of labor increased rapidly. The cows were kept in the barn all the time after about December 1. The extra labor indicated by the clear portion of the bar was largely in marketing cream. By co-operating with neighbors, the time thus spent was considerably reduced.

In general, the distribution of labor on dairy cows fits in well with crop labor demands. There is some conflict at seeding time; but dur-

ing the rush of harvesting, threshing, and silo filling the cows require the least labor of any season of the year. From April to November, inclusive, the cows require only two-thirds as much labor per day as during the four winter months.

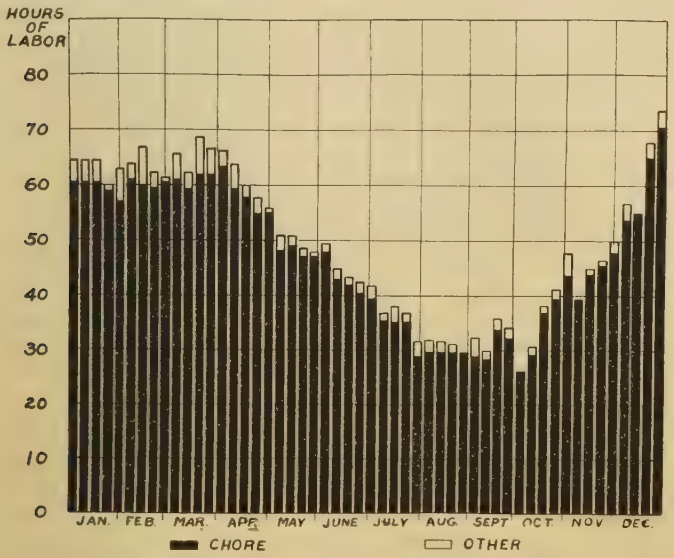

Fig. 5. Distribution of Man Labor by Weeks on 20 Milk Cows

Dairy cows make a heavy and continuous demand for labor. By practicing fall freshening it is possible to get the peak labor load in winter time and a slack period during the rush of harvest and silo filling.

Young Dairy Cattle

Description of Enterprise

"Young dairy cattle" includes all dairy cattle on the farm except the milk cows—all heifers up to the time of birth of their first calf, and all bulls. It may include a few steers or heifers that are intended for slaughter, but ordinarily the culls are sold as veal. Practically all the young dairy cattle raised are intended for the herd or for sale as breeding stock to other dairymen.

It is the usual practice on these farms to wean calves at birth or within a few days. Even calves intended for veal are not left with their dams more than a few days. All calves are fed whole milk immediately after weaning, and for calves to be vealed, whole milk may be continued until they are ready for market. Whole milk is gradually replaced with skimmilk for calves that are to be raised except that especially promising purebred calves may receive whole milk for several months. Eighty-seven living calves were dropped each

year for every 100 cows maintained. Of each 100 calves dropped, 5 died as calves and 1 before maturity, 43 were butchered or sold as veals, 4 were butchered or sold as yearlings or older, 12 were sold as breeding heifers, 10 as breeding bulls, and 25 freshened as heifers and were added to the milking herd. Practically all the grade bull calves were sold as veal and all purebred bulls for breeding purposes. Herd bulls are purchased from other herds, usually as calves. All purebred heifers are raised for sale or as additions to the herd. Approximately three-fourths of the heifer calves from the better grade cows are also raised for sale or for trial in the herd.

The amounts of feeds and of labor and materials used for these young dairy cattle are presented in Table VII. This class includes all ages of young cattle from birth to maturity as well as the herd bulls. However, the composition of the different herds is fairly uniform and the distribution by ages does not vary widely. No attempt was made to compute a unit of physical production for this group. The stock produced was the product, but its value varied so widely with the breeding and individuality of the animals that a weight figure would have little significance.

Variations in Feeds

As for cows, the feed for young cattle is varied according to the farmer's judgment and his general plan of herd management. On Farms 9, 20, 21, 23, and 31, a special effort is made to grow out the young stock to good size. All young cattle are fed grain continuously and are not turned on pasture until more than a year old. The better dairymen pay special attention to getting steady and rapid growth in both young bulls and heifers. The high feed consumption on Farm 20 is in part due to the fact that a purebred herd is maintained which is fitted for the show circuit. The cattle are heavily fed throughout the year, even while on pasture.

The lighter feeding of milk during 1920 and 1921 is due in some measure to the fact that the young cattle herds included relatively fewer young calves.

Variations in Labor

The labor spent on young dairy cattle varies with the methods of handling and the convenience of barn and lot arrangement. The labor on Farm 34 is kept down by very convenient facilities for handling the young cattle. On Farms 9, 19, and 23, on the other hand, lack of such facilities is a factor in high expenditures. In general, less time is spent in caring for the young cattle on farms maintaining low producing cows than on those having high producers. Purebred cattle receive more attention than grades. The size of the young cattle herd is also a factor affecting labor. In general, the larger the herd, the less the

labor per head. The high labor item on Farm 20 is due to the fitting and showing of the herd, as already mentioned. On account of the mixed composition of this class, none of these causes for variation stand out clearly in Table V.

Veterinary Service and Medicine

The charges for veterinary service and medicine for young dairy cattle are small. The most important items are testing for tuberculosis, and disinfectants.

Standards for Young Dairy Cattle

On account of the variability in composition of the young dairy cattle herds, it is difficult to set up standards of much significance. Separate standards for each of the various ages and classes included in this group would be much more valuable but can not be computed from data available. The standards given assume a herd of at least 15, including a herd bull, 7 calves, 5 yearlings, and 2 two-year olds.

Grain, pounds	500
Hay, alfalfa or clover, pounds	2000
Silage, pounds	4000
Whole milk, pounds	225
Skimmilk, pounds	1800
Pasture, days	60
Man labor, hours	40
Horse labor, hours	5
Cash costs (veterinary services and medicine), cents	20

Distribution of Labor on Young Dairy Cattle

The distribution of labor on a herd averaging 17 head is shown in Figure 6. These are part of the dairy herd for which the distribution of labor on cows is shown in Figure 5. The seasonal variation follows the same general direction as that on cows but fluctuates more widely. As has been mentioned, the calves are born in September, October, and November. This, together with the end of the pasture season for yearlings and two-year olds, results in a sharp increase in labor in November. The labor expended is practically constant until the cattle are turned out in the spring. During the summer, labor consists largely in the care of the bull, as all young cattle are on pasture by July 1. As with cows, the care of young cattle conflicts to some extent with labor on crops at seeding time, but throughout the rest of the crop season the labor is so light that competition is insignificant.

TABLE VII

AMOUNTS OF FEED, LABOR, AND MATERIALS USED PER HEAD PER YEAR FOR YOUNG DAIRY CATTLE, 1924

Farm No.	No. of head	Farm grains	Commercial feeds	Tame hay	Wild hay	Alfalfa	Corn fodder	Silage	Whole milk	Skim-milk	Pasture	Total grain	Total dry roughage	Vet. services, etc.	Man labor	Horse work
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	days	lbs.	lbs.		hrs.	hrs.
7	7.3	64	...	399	...	500	533	3027	71	818	8	64	1432	$0.09	20	1
23	9.0	500	...	2018	...	...	...	3655	446	1795	52	500	2018	0.22	58	1
19	9.3	382	37	1313	...	...	84	3810	222	1743	49	419	1397	0.18	45	6
13	10.9	330	5	351	...	235	121	1445	465	1688	46	335	707	....	15	3
17	11.9	277	...	1314	50	...	188	7317	227	1963	64	277	1552	0.10	61	13
31	13.8	446	...	956	...	319	504	4952	42	2186	66	446	1779	0.11	34	4
35	14.4	158	...	425	...	...	875	3179	243	2976	32	158	1300	1.45	36	3
20	14.5	1086	18	553	...	1632	...	3006	372	4467	31	1104	2185	....	83	12
28	16.1	149	6	638	...	90	781	2479	231	575	30	155	1509	0.16	42	2
27	16.2	225	6	422	...	586	19	4171	167	1726	49	231	1027	....	31	1
18	17.3	290	7	655	...	840	507	4446	114	1683	65	297	2002	0.12	37	5
25	17.8	93	...	38	575	133	869	6540	414	1972	75	93	1615	0.11	47	7
14	18.0	313	...	500	...	720	357	3108	233	1894	60	313	1577	0.03	44	1
5	18.3	326	...	1742	...	334	...	3174	229	993	77	326	2076	0.07	29	3
1	20.3	185	8	388	...	1391	...	3306	270	2361	40	193	1779	0.16	37	4
9	20.4	491	5	...	197	1605	...	4140	79	3207	44	496	1802	0.42	56	4
24	20.6	275	...	389	37	319	146	4812	100	1828	62	275	891	0.10	33	4
10	23.9	295	...	258	258	218	...	3399	198	1590	33	295	734	0.13	34	2
34	26.0	54	...	...	433	448	38	3131	...	854	76	54	919	0.13	9	2
26	31.6	250	2	1175	126	...	16	3755	180	1553	67	252	1317	0.09	43	1
21	35.0	510	...	1343	...	421	...	4510	240	1763	50	510	1764	0.17	30	2
Averages																
373	head, 1924	316	4	688	99	484	203	3907	204	1862	53	320	1474	0.18	38	4
369	" 1923	431	9	741	145	284	316	3627	215	1840	67	440	1486	0.19	42	3
356	" 1922	363	10	1100	187	374	310	3174	58	2483	54	373	1971	0.08	48	2
357	" 1921	331	21	1203	114	81	124	3657	1	1708	85	352	1522	0.02	41	1
395	" 1920	344	37	1376	152	...	316	3500	67	1103	64	381	1844	0.21	22	2

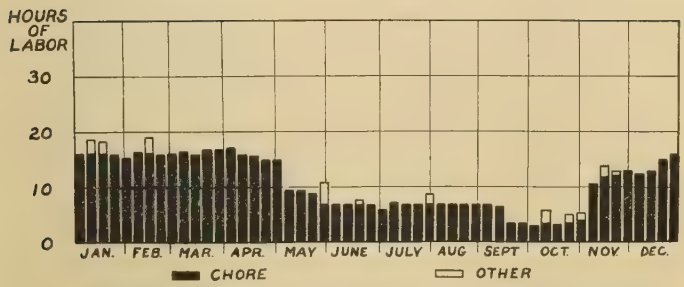

Fig. 6. Distribution of Man Labor by Weeks on 17 Head of Young Dairy Cattle

The labor expended on young dairy cattle shows a wider seasonal variation than for cows, but the general direction of the variation is practically the same.

Swine

Description of Enterprise

Swine are second only to dairy cattle in importance as a source of income on these farms. They offer a means of utilizing the large amount of skimmilk from the dairy herd as well as a market for a considerable quantity of corn and other farm grains. The availability of skimmilk as a protein supplement enables these dairymen to feed their hogs a well balanced ration without the necessity of purchasing large quantities of tankage and other expensive commercial feeds. This gives the dairyman selling cream an advantage in pork production over one who sells whole milk and over farmers who do not keep dairy cows. Swine are maintained primarily for pork production. There are several purebred herds from which considerable breeding stock is sold, but on most farms hogs are sold for slaughter. Duroc-Jersey and Poland China are the breeds most commonly used. Purebred boars are used almost exclusively and in most cases the sows, if not registered, would have been eligible to registry if records had been kept on the breeding stock. In only a few herds were grades or cross-breds to be found. The general quality of the breeding stock is very good.

Breeding practices vary quite widely. From 60 to 70 per cent of these farmers raise two litters per year with some of their sows. Seventy per cent of all pigs raised are farrowed in the spring and 30 per cent in the fall. There is a distinct advantage in having some fall litters to use the large amount of skimmilk available during the fall and winter; also because the weather is usually more favorable for farrowing than in early spring. If two litters a year are raised, the spring pigs are usually farrowed in March or early April. If only one litter is raised, farrowings are often delayed until May or even June. Gilts are commonly used for breeding purposes when only one litter is desired but more aged sows are generally used when two

litters a year are raised. On the average, 5 pigs per litter were raised to maturity or market age for the five years. The average was slightly higher in fall than in spring litters. Altho these farmers have a distinct advantage in raising pigs on account of the skimmilk available, this is in part offset in many cases by cold, poorly lighted, and poorly ventilated hog houses and by buildings and lots infected with disease and infested with parasites as a result of over-crowding and poor sanitation.

The average weight of hogs marketed was 219 pounds. Some farmers regularly feed their hogs to weights of 240 or 250 pounds, while others sell at about 200 pounds. The percentage of hogs marketed each month is as follows: January 7.2, February 6.6, March 6.8, April 9.5, May 11.9, June 5.1, July 3.6, August 2.8, September 3.8, October 11.4, November 13.9, and December 17.4. The bulk of the spring pigs are marketed during the last three months of the year. Only a few farmers succeeded in feeding out their spring pigs for the September market. The heaviest run of fall pigs is ready for market in May. That the sales during July, August, and September included a large number of heavy sows, is indicated by the fact that the average marketing weight was over 300 pounds. The amounts of feed and labor used for pork production are presented in Table VIII. Corn constituted about two-thirds of the grain ration. The small grain ration was largely oats and barley or mixtures of the two. The mill feed included standard middlings, flour middlings, and red dog flour. Pasture was used on nearly all farms. The pasture crops included alfalfa, rape, clover and timothy, and bluegrass. Some buttermilk is included with the skimmilk. The pork produced includes the net gain in weight of all hogs on the farm during the year. It is obtained by adding live weight of all hogs sold, or butchered for home consumption, during the year, and the weight of hogs on hand at the end of the year, and subtracting from this the weight of those on hand at the beginning of the year, and any purchased during the year. The figure obtained is net and covers death risk, as no allowance is made for hogs that died during the year. The feed per 100 pounds of pork produced included the maintenance feed for the breeding herd which produced the pigs actually marketed. Data for 1923 are presented instead of for 1924, as with other classes of livestock. The corn crop in 1924 was scarce and poor. As corn is the principal hog feed, more representative figures are obtained from a normal corn year.

TABLE VIII

AMOUNTS OF FEED, LABOR, AND MATERIALS USED FOR PRODUCTION OF 100 POUNDS OF PORK

Farm No.	Pork produced	Corn	Small grain	Mill feeds	Total grain	Tankage	Skimmilk	Pasture	Man labor	Horse work	Vet. service and medicine
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	days	hrs.	hrs.	cents
28	16,198	187	109	..	296	....	333	7	5.4	0.6	..
4	14,125	148	157	5	310	2.8	317	28	4.1	0.5	..
13	12,335	227	112	..	339	....	352	..	3.8	0.4	..
23	25,802	267	81	4	352	16.6	323	35	3.4	0.4	..
10	11,472	214	146	..	360	....	277	24	4.5	..	..
25	8,255	176	183	6	365	....	1154	24	10.7	1.2	..
20	9,999	337	41	..	378	....	106	62	6.4	1.1	..
5	11,610	315	39	..	384	....	836	14	4.6	0.9	..
31	31,628	223	162	..	385	4.3	144	27	2.9	0.5	16
6	27,869	220	168	3	391	5.2	297	19	3.8	0.6	..
27	10,719	245	128	19	392	....	296	51	7.2	0.5	..
30	20,849	330	57	6	393	12.4	22	31	3.8	1.6	..
18	22,228	284	144	..	428	....	400	36	4.5	1.0	..
22	18,607	196	233	..	429	....	442	70	5.3	0.6	..
9	9,675	295	170	..	465	....	1017	7	8.6	..	..
1	6,142	322	152	13	487	8.1	1099	28	10.2	5.2	..
21	55,664	284	217	2	503	6.6	200	32	6.7	0.6	11
26	13,080	363	196	2	561	....	844	21	5.6	0.1	..
14	8,967	365	240	..	605	....	693	9	10.6	2.2	..
15	20,742	316	245	50	611	....	411	36	6.3	0.9	9
24	10,803	337	297	..	634	0.9	475	16	6.7	0.6	1
Averages											
1923	17,465	266	161	5	432	4.3	377	29	5.4	0.7	5
1924	13,136	292	149	12	453	2.7	464	36	5.5	0.6	3
1922	13,668	320	130	12	462	0.8	358	29	5.4	0.5	3
1921	10,040	263	119	11	393	3.8	300	39	6.2	0.7	3
1920	11,184	279	93	13	385	2.5	290	20	5.1	0.5	7

Variations in Feed

Number of pigs raised per sow.—Generally less feed is used for 100 pounds of pork when large litters are raised. On Farms 4, 13, and 28, using the least, the average number of pigs per litter was 6.2. The average size of litter on Farms 14, 15, and 24, using the most feeds, was only 3.3 pigs. An additional factor affecting feeds on these two groups of farms was the number of litters raised each year per sow. In the low-feed group each sow raised two litters, while in the high-feed group only a third of the sows raised more than one litter. As the feed for the brood sows is charged against the pigs they produce, the more pigs each sow produces the less will be the charge per pig or per 100 pounds of pork produced.

Weight of breeding stock.—A factor in the amount of feeds on Farms 15 and 21 is the weight of the breeding stock. These are purebred herds raising considerable stock to sell for breeding purposes. The brood sows are largely aged sows weighing 500 to 600 pounds apiece. They are approximately twice as heavy as the gilts that are commonly used on farms where hogs are raised only for slaughter.

Practices with purebred herds.—In addition to the weight of brood sows, mentioned as a factor in increasing feeds, certain practices tend toward this result. In order to get the maximum growth, gilts are sometimes not bred to farrow till about eighteen months of age, while twelve months is the usual age in most herds. Extra feed is used while the purebred herds are being fitted for the show circuit. Fall litters are often sacrificed in order to have the sows available for showing in the fall, while all aged sows raise two litters each year if hogs are raised for slaughter. These factors contribute to the large amount of feeds on Farm 21.

Kind of ration used.—The amount of protein in the ration, and the kind of pasture used are important factors determining feeds. On Farm 31, 763 pounds of grain was required to produce 100 pounds of pork in 1920 as compared with 385 pounds in 1923, as shown in Table VIII. In 1920 the ration consisted largely of such fattening feeds as corn and barley. Bluegrass was used as pasture. Brood sows were fed corn exclusively and produced small, weak litters. In 1923 a grain ration 50 per cent richer in protein was used. Alfalfa pasture was substituted for bluegrass. Oats replaced corn for the brood sows and 6.4 pigs were raised per litter instead of 3.1. Almost twice as much pork was produced per 100 pounds of grain fed.

Quantity of feed available.—Skimmilk is necessarily fed when it is produced. It is used to best advantage when fed to young pigs. However, if only one litter a year is raised, there is only a short time when young pigs are available to utilize this skimmilk. The rest of

the year it is fed to more mature stock. Raising two litters a year results in a better utilization of this by-product of the dairy enterprise. If the hog enterprise is small and the dairy enterprise large, as on Farms 1 and 25, most of the skimmilk is fed to more mature hogs and in such quantities that they do not make the most economical use of it. On Farm 36, on the other hand, the relation of the dairy and hog enterprises is reversed and the skimmilk feeding is light.

Weights at which hogs are marketed.—On Farm 23 there were few pigs in 1922 and in order to market the available grain, the pigs were fed out to an average weight of 287 pounds. In 1923 there were more pigs and they were fed out to a weight of 206 pounds. All other conditions were practically the same. Approximately 20 per cent less grain was required to produce 100 pounds of gain with the lighter hogs.

Purchase of feeder pigs.—On Farm 6 more than half the hogs marketed were bought as feeders. As no feed for the breeding herd which produced them is charged against these pigs, the amounts are somewhat lower than they would otherwise be.

Variations in Labor

Size of herd.—One of the most imortant factors affecting the labor used to produce 100 pounds of pork is the amount produced per farm. The larger the herd the less the labor. Farms producing less than 10,000 pounds of pork annually use more than twice as much labor per 100 pounds as farms producing over 20,000 pounds. It takes comparatively little longer to feed 100 hogs than to feed 50.

Feeding conveniences.—On farms 13 and 26 the amount of pork produced, size of litters, proportion of spring and fall farrowing, and other factors affecting labor are quite similar. However, nearly 50 per cent more labor was used to produce 100 pounds of pork on Farm 26 than on Farm 23, where the convenient arrangement of hog house and hog lots was an important factor in labor saving.

Raising purebred stock.—On Farms 15 and 21 the labor is considerably higher than the average in spite of the advantages of large production and convenient facilities for handling and feeding. Considerable extra time is spent with these purebred herds in fitting the hogs for show, showing them to prospective purchasers, selling singly or in small lots, attending sales, and caring for the details of pedigrees and registration.

Hogging-off corn.—The low labor on Farms 31 and 36 was in part due to the saving of labor through hogging-off corn.

Veterinary Service and Medicine

Veterinary service and medicine are of very minor importance as cost items on these farms. On Farms 15 and 21 the whole herds were vaccinated. These were purebred herds from which breeding stock was sold. The expense on Farm 31 was largely for disinfectants, worm powders, and mineral feed.

Standards for the Production of 100 Pounds of Pork

Grain, pounds	375
Skimmilk, pounds	350
Pasture (alfalfa, rape or clover), days	30
Man labor, hours	4.0
Horse work, hours	0.5

These standards are for hogs raised for slaughter rather than for purebred breeding stock. Good sized litters should be raised, death losses avoided, and the desirable practices mentioned in previous paragraphs should be followed if these standards are to be attained. The figure for skimmilk is based on the amount likely to be available and the grain is adjusted accordingly, recognizing the fact that during a part of the year the skimmilk must be fed to heavy hogs, and also in varying quantities. With the best possible adjustment of the swine enterprise to the milk supply, the grain might be reduced still further. The estimate for labor assumes the production of at least 12,000 pounds of pork annually per farm.

Distribution of Labor on Swine

The distribution of labor on swine for a farm producing 12,000 pounds of pork a year is shown in Figure 7. The labor distribution is fairly uniform throughout most of the year. Reduced numbers following sales in February reduce the labor somewhat, but March farrowings increase it. During the summer pasture season, less than half as much labor is used. The fall farrowing, the first week in September, again increases labor. It continues to increase with the

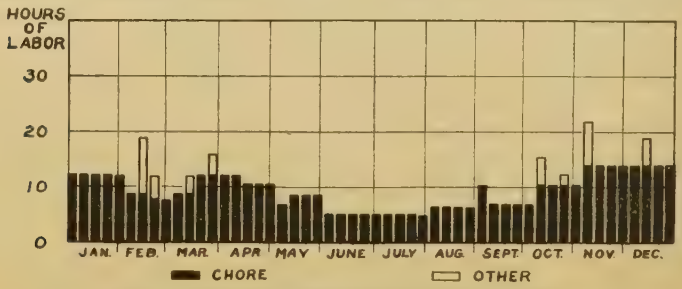

Fig. 7. Distribution of Man Labor by Weeks on Swine

By raising spring and fall litters the labor for hogs is spread fairly evenly throughout the year except during the summer pasture season, when it drops to about half the winter level.

heavier feeding of the spring pigs for October and November marketing. The fall pigs are weaned about November 1, thus increasing the labor still further. The "other labor" indicated by the clear portion of the bar is marketing work. This distinction is fairly representative for farms raising two litters per year.

Poultry

Description of Enterprise

There is a wide variation in the kind and quality of chickens on these farms as well as in methods of handling them. Both Mediterranean and American breeds are raised, often on the same farm. Poultry, like hogs, can utilize skimmilk advantageously, but there is considerable variation in the extent of its use. The amounts of feed, labor, and materials used per 100 mature chickens are shown in Table IX. In computing the average number of mature chickens, all birds under six months of age are figured as half of a mature chicken. The feed for the laying flock is combined with that for growing chicks so it is necessary to express the combined product in terms of both eggs and poultry. The feeds include only those actually fed. In addition to this the chickens forage about the farmstead and adjoining fields for a considerable part of their living. Much of the feed they pick up would otherwise be wasted.

Variations in Feeds

Feeds for poultry vary widely with practices and conditions on the farms. If a considerable amount of waste grain and other products is available, less marketable feed is required. If the farmer is satisfied with low production and allows the hens to forage for most of their living, they are fed very little. In general, there is a closer relation between feeds and meat production than between feeds and egg production. Little chicks can not forage for as large a proportion of their living as can mature stock. The farms producing more than the average quantity of meat used 55 per cent more feed per 100 birds than did those producing less than the average amount. The larger flocks also used somewhat more feed than the smaller, as the waste products to be picked up are less per bird.

Variations in Labor

The amount of labor tends to decrease as size of flock increases. It also decreases with added conveniences for handling the poultry. The amount of labor is much lower where the poultry work is done by men, as on Farms 13 and 36. Altho the time spent by women and children has been scaled down to a man-equivalent basis, it seems that, as the care of poultry is more or less a pastime, they do work that does not appear essential to the maintenance of the flock. If

men care for the poultry they pay more attention to providing labor-saving equipment. More labor is required where incubators and brooders are used. The use of such equipment accounts in part for the large amount of labor on Farms 6, 7, and 31.

Variations in Egg Production

Egg production varied with the care and attention given the poultry, the rations fed, the extent to which culling is practiced, and the type, quality, and adequacy of the housing facilities. On Farms 9, 13, 28, and 36 very careful culling and good feeding methods are practiced. Farms 13 and 28 have excellent poultry houses. Part of the difference in egg production is due to differences in the flock rather than entirely to the laying performance of the hens kept. As all roosters and all pullets or cockerels raised for sale are included, flocks having a large percentage of such birds will show lower egg production even tho the hens may be laying just as well as those in other flocks. On Farm 6, 5553 eggs were produced per 100 chickens, but as the hens constituted less than half the average number of chickens, the number of eggs per 100 hens was 11,500. Farm 24, having slightly more eggs per 100 chickens, had only 7300 eggs per 100 hens because the hens constituted a larger proportion of the whole flock.

Medicine, Disinfectants, etc.

One of the principal poultry problems on these farms is sanitation and disease control. The regular use of disinfectants is an important part of good poultry practice.

Standards for Poultry

It is difficult to work out standards for poultry that will be generally applicable because of the varying conditions under which they are kept on different farms. Where housing and sanitation are good and where flocks are as carefully culled and as well fed as they are on the farms where poultry received reasonably good care, for a flock of 200 chickens producing 6500 eggs and 300 pounds of meat per 100 birds, the following standards are suggested.

Grain, pounds	3500
Skimmilk, pounds	2000
Man labor, hours	175
Horse work, hours	4
Medicine and disinfectants	$2.00

In computing these standards it is assumed that the flock is given free range about the farmstead and fields.

TABLE IX

AMOUNTS OF FEEDS, LABOR, AND MATERIALS USED AND PRODUCTION PER 100 CHICKENS, 1924

Farm No.	No. of chickens		Corn	Oats and barley	Wheat	Mill feeds	Total grain	Skim-milk	Meat scraps	Man labor	Horse work	Medicine, disinfectants etc.	No. of eggs laid	Poultry produced
			lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	hrs.	hrs.			lbs.
25	80		...	1565	...	...	1565	....	...	262	5.0	...	3000	64
1	135		737	924	...	...	1661	1670	...	184	8.0	...	4813	86
36	150		1189	1007	798	393	3387	....	...	96	1.0	$3.83	10120	—43*
34	150		3332	4884	...	177	8393	2208	100	174	38.0	0.83	3072	1081
6	165		105	4571	1096	...	5772	1417	...	300	3.0	1.54	5553	433
18	165		218	3434	193	30	3875	719	...	235	4.8	3.27	4424	286
23	175		...	887	3609	...	4496	...	...	227	...	1.42	5230	567
5	190		79	2454	2023	...	4556	1205	52	226	2.6	3.29	6865	116
19	220		576	1767	274	45	2662	555	...	172	3.6	1.25	4265	150
17	225		162	810	673	578	2223	538	...	254	6.7	1.42	5268	21
31	230		122	2034	1173	633	3962	953	43	269	4.0	2.52	6008	542
9	250		215	1670	...	...	1885	776	...	203	...	0.40	6736	166
28	300		1012	1758	1276	100	4146	1173	67	230	0.7	4.92	8571	195
14	300		...	3229	467	83	3779	899	...	158	...	0.46	2519	515
24	320		458	3609	152	125	4344	633	14	161	...	2.42	5708	304
13	360		581	1698	1736	39	4054	2367	31	54	1.9	...	6658	224
7	375		130	4030	1385	116	5661	1416	...	57	...	0.67	5106	159
Averages														
3790	chickens	1924	475	2455	936	140	4006	1056	19	178	3.5	1.66	5644	285
4062	"	1923	457	1830	986	105	3378	995	13	175	5.0	0.90	5285	291
2875	"	1922	320	886	518	81	1805	269	9	179	5.4	0.88	4810	493
2846	"	1921	80	770	541	14	1405	195	...	161	3.2	1.04	4296	291
2673	"	1920	930	1909	349	79	3267	763	...	342	3.4	2.17	5266	248

* Minus sign indicates loss of weight.

Distribution of Labor on Poultry

The distribution of man labor on a flock averaging 165 chickens is shown in Figure 8. The average number of laying hens during the year was 80; the production per 100 birds was 5553 eggs and 433 pounds of meat. The labor distribution is quite uniform during the year except during and following the hatching season. Altho the laying flock needs less attention when on free range, the care of the growing chicks more than offsets this decrease. As most of the work on poultry is done by women and children, the enterprise does not compete seriously for labor with the major enterprises of the farm.

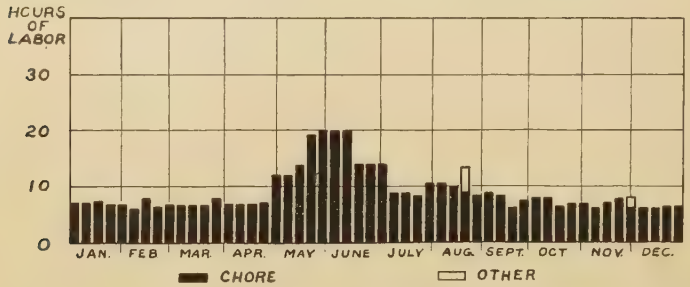

Fig. 8. Distribution of Man Labor by Weeks on Poultry

The labor used by poultry is quite uniform, except during the hatching and rearing season in May and June. Since the labor demand is low and most of the work is done by women and children, poultry does not compete seriously for the farmer's time.

Work Horses

Description of Enterprise

Horses are the main source of motive power on these farms but are supplemented by tractors on a little more than half of them. The horses are of ordinary grade stock, averaging in weight about 1350 pounds. Purebred horses are kept on only one farm; on other farms the horses are kept for work rather than for breeding purposes. Only occasionally are colts raised, and these only to maintain the supply of work stock. The amounts of feed and labor used for work horses are presented in Table X. All broken horses of working age, whether mares or geldings, are included. The data for colts will be presented separately.

Variations in Feeds for Work Horses

Amount of work performed by horses.—Altho other factors tend to offset it in individual cases, the more hours of work a horse performs annually the greater the amount of feed needed. The least grain is fed on Farm 7, where the horses work the fewest hours. It is lower than the average on Farm 17, altho the hours per horse are

highest there, because the horses were much smaller than the average and the higher number of hours does not represent an increased amount of work.

Kinds of feed.—The use of pasture saves both grain and roughage. Such a saving occurred on Farm 7, and of grain alone on Farm 25. A full analysis of the roughage figures is impossible, as no record of straw consumed is available. The roughage fed is low on Farms 17 and 24 because the horses receive considerable straw in addition. The roughage fed on Farms 13 and 31 is high because the horses receive no straw. Wild hay, corn fodder, and stover are usually fed more liberally than tame hay, as more or less waste is involved. Heavy roughage feeding may compensate for lighter grain feeding. This is apparent in a comparison of the average for 1924 with that of other years.

Variations in Man Labor on Horses

Amount of work performed by horses.—Where the horses work more hours per head, more man labor is spent on them. There are exceptions to this, as on Farm 5, where the horses are on pasture more than twice the usual period; or on Farm 36, where the horses are turned out in the fields in winter, fed hay in outdoor racks, and only the grain is fed in the barn.

Methods of care and handling.—Extensive use of pasture usually saves labor. However, on Farm 9, altho the average number of pasture days is high, the labor per horse is also nearly up to the average, because some of the horses are in pasture practically the whole summer; but the labor on the horses that were worked was enough to offset this. The practice of roughing the horses through the winter, as mentioned in the previous paragraph regarding Farm 36, also saves labor. It accounted in part for the small amount of labor on Farm 34 where, altho little pasture is used, the horses are turned out in the yard when not working.

Standards for Work Horses

The following standards are suggested for a 1500-pound horse working 1000 hours per year. In computing these it is assumed that the horses are working at the usual work done on these farms and in such units that their full capacity is realized. If tractors are available for heavier work, such as plowing, these standards may be reduced somewhat. The amount of roughage will vary with the kind used. In suggesting the feeds, it is assumed that some straw will be used in winter.

Grain, pounds	3000
Roughage, pounds	5000
Pasture, days	60
Man labor, hours	80
Cash costs	$1.25

TABLE X

AMOUNTS OF FEED, LABOR, AND MATERIALS USED FOR A YEAR FOR A WORK HORSE, 1924

Farm No.	No. of horses per farm	Corn	Small grain	Tame hay	Wild hay and fodder	Shredded stover	Pasture	Total grain	Total roughage	Man labor	Shoeing, Vet. services medicine	Total hours worked
		lbs.	lbs.	lbs.	lbs.	lbs.	days	lbs.	lbs.	hrs.		
7*	5.0	...	748	2488	931	489	122	748	3908	33	$0.18	516
14*	5.0	857	3372	2135	800	4424	25	4229	7359	114	0.06	638
24*	6.0	...	2176	975	1597	580	81	2176	3152	100	0.49	645
26†	11.0	403	2911	1610	2819	583	42	3314	5012	70	0.13	650
20	10.1	...	2647	2958	4762	...	94	2647	7720	88	...	708
27	6.3	374	1640	2426	....	1059	77	2014	3485	81	...	720
18	7.5	169	2803	3978	798	2073	97	2972	6849	83	1.38	758
21*	6.9	490	3101	....	5564	....	9	3591	5564	98	2.11	769
25	9.1	923	....	146	7671	....	108	923	7817	105	1.64	775
31*	6.2	80	2422	1904	2364	4472	30	2502	8740	73	0.25	790
35†	5.0	417	1990	4065	....	....	62	2407	4065	99	0.98	807
23*	6.0	62	2468	4228	2167	....	51	2530	6395	75	...	821
6*	6.8	...	3822	3957	....	1406	68	3822	5363	92	1.81	843
19	6.0	336	2694	3895	1815	....	51	3030	5710	102	2.45	850
34	6.0	1599	2537	365	3454	....	10	4136	3819	37	1.93	926
9	9.0	447	2132	1430	4927	....	102	2579	6357	79	0.44	956
1	5.7	540	1753	4031	....	2573	75	2293	6604	91	0.26	973
5*	6.2	554	2214	2986	1627	....	160	2768	4613	68	1.78	980
13	4.0	...	3263	4468	1784	1936	...	3263	8188	100	0.32	1002
36	5.2	1252	2595	4554	580	....	15	3847	5134	80	4.94	1096
10	5.5	818	1821	1321	3773	....	56	2639	5094	104	0.61	1129
28*	4.1	497	2590	1131	1691	2102	...	3087	4924	101	1.79	1154
17	6.3	114	2211	1593	1664	446	79	2325	3703	101	0.15	1170
Averages												
149 horses	1924	423	2326	2358	2523	847	66	2749	5728	85	0.98	870
152 "	1923	1196	1646	1873	1519	698	66	2842	4090	88	1.02	797
152 "	1922	2050	1537	2023	1640	1050	44	3587	4713	88	1.22	843
137 "	1921	1915	993	2855	1017	1114	58	2908	4986	97	1.23	830
144 "	1920	1398	1592	2447	1341	870	44	2990	4658	86	1.07	835

* Tractor used for drawbar work.

† Tractor used only for belt work in 1924, but available for drawbar work.

Distribution of Man Labor on Horses

The distribution of man labor on 6 horses is shown in Figure 9. It is much more uniform than that on the productive livestock. The horses receive some extra attention as the rush of spring work starts, but during the summer there is little variation. This distribution is representative for these farms. There is much more variation in the amount of labor spent on horses than in the seasonal distribution.

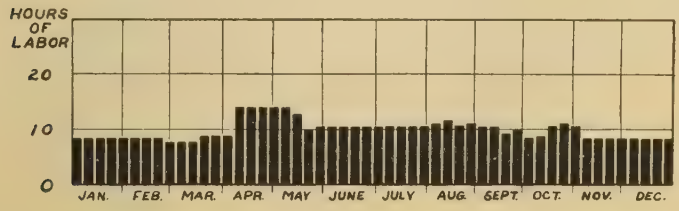

Fig. 9. Distribution of Man Labor by Weeks on Horses

Work horses demand steady regular attention throughout the year. Even when idle in winter they take only a little less of the farmer's time than during the busy summer season.

Colts

Description of Enterprise

Colts are maintained on about half the farms studied, but only a few are raised per farm. They are all grade colts except on Farm 20, and are raised for the purpose of replacing the work horses. Only on Farm 20 were colts raised for sale. The enterprise includes colts under one year, yearlings, two-year-olds, and even some unbroken three-year-olds.

Feed and Labor Used

The units of feed, labor, and materials used for colts are shown in Table XI. Because of the variation in age of the colts on different farms and varying methods of care, there is a wide range in amounts used. On Farms 14, 18, and 31, the colts are given considerable grain and grown to good size. On Farms 5 and 25, the colts run on pasture most of the year, receive little grain, and depend on straw for much of their roughage. The amount of grain fed on Farm 20 is low because considerable grain in the roughage is reported as fodder. No pasture is reported for Farms 1, 18, 24, and 25. On the first two the colts were on hand only during the winter season and on the other two the colts were born in 1924 and no pasture is charged the first season.

TABLE XI

AMOUNTS OF FEED, LABOR, AND MATERIALS USED PER YEAR FOR A COLT

Farm No.	No. colts per farm	Corn	Small grain	Tame hay	Wild hay and fodder	Shredded stover	Pasture	Total grain	Total roughage	Man labor	Vet. services and medicine
		lbs.	lbs.	lbs.	lbs.	lbs.	days	lbs.	lbs.	hours	
18	0.3	...	2323	...	...	4335	...	2323	4335	8	....
24	0.6	...	1059	952	264	....	...	1059	1216	15	....
1	0.6	...	1165	2536	...	1967	...	1165	4503	65	....
5	1.0	...	492	1150	...	....	278	492	1150	18	$0.75
14	1.0	...	1520	1263	360	610	188	1520	2233	85	....
36	1.1	407	851	1747	...	....	168	1258	1747	..	....
25	1.4	246	336	694	...	....	...	582	694	38	....
31	1.7	...	1091	884	...	167	211	1091	1051	12	....
9	2.0	149	481	300	775	....	245	630	1075	59	....
20	3.7	...	140	285	3784	....	263	140	4069	39	....
26	5.4	73	430	285	394	207	159	503	886	29	....
Averages											
19 head	1924	61	590	621	1020	232	178	651	1873	37	0.04
26 "	1923	225	375	265	345	370	208	600	980	26	....
22 "	1922	500	367	1091	551	476	203	867	2118	15	0.63
27 "	1921	851	315	825	633	211	143	1166	1669	12	0.92
22 "	1920	493	339	678	545	843	161	832	2066	33	0.04

The labor varies even more widely than the feed. On Farm 36 the colts have the run of the farm, are fed with the work horses, and require so little extra care that no record was made of it. On Farm 14, the colts receive practically the same attention as a work horse. Colts require little of the farmer's time except in winter, and then so little as to be insignificant.

Standards for Colts

On account of the variability of the enterprise it is very difficult to compute significant standards for colts. On the basis of a careful study of the records, it appears that with the following amounts of feed and labor it is possible to raise a colt from birth to three years of age satisfactorily.

Grain, pounds	3000
Hay, clover or alfalfa, pounds	6000
Pasture	Three seasons
Man labor, hours	75

Expenditures of Labor and Materials for Crops

A knowledge of basic unit expenditures is essential to any study of the crop phases of farm organization. These expenditures include hours of man labor, hours of horse and tractor work, and quantities of seed, twine, and other materials used in the production of the crops considered. It is equally important to know the seasonal distribution of the labor for each crop and the probable days available for each of the crop operations. With these data available, the farmer is able to forecast in advance the effect of changes in his cropping system on his resources and on his returns.

On pages 96 to 108 in the appendix are tables showing the physical expenditures for the production of the principal farm crops grown on the farms studied, the expenditures for each farm for 1922, and weighted averages for all farms for each of the five years included in the study. The year 1922 was selected because general weather conditions were more nearly typical for the area than in any other of the four years. A wide range is apparent even tho these farms are in a locality where soil and climatic conditions are quite uniform. No attempt will be made to discuss in detail the causes for such variations.[2] However, one cause of variation is the extensive use of tractors. In these tables only hours of drawbar work for tractors are shown, as it is only at such work that horses and tractors are used interchangeably. The hours of tractor belt work (filling silos and shredding corn)

[2] For such a discussion see Minn. Agr. Exp. Sta. Bull. 205, "Farm Organization in Southwestern Minnesota" by G. A. Pond and J. W. Tapp; also issued as U.S. Dept. of Agr. Bull. 1271. Soil, climatic, and other conditions affecting farm operation are fairly comparable in these two areas and variations in physical costs are caused largely by the same factors.

have not been included. Many farmers hire the power for these operations. For the sake of uniformity all such work has been omitted.

In presenting the data for small grain, all small grain crops are combined. As they are largely raised for feed they are commonly grown in mixtures. Even when grown separately they are often harvested and threshed together and fed in mixtures, hence it was impossible clearly to separate labor between different crops, practices being fairly uniform. Any variations will be noted in the discussion of each crop. The yield is reported in pounds instead of bushels because of the mixtures.

In addition to showing the actual physical expenditures for these farms, standards are given which represent what may be reasonably expected under good management. They represent approximately the attainment of farmers who are found in the upper 25 per cent in the scale of efficiency as measured by low labor expenditure for a given operation. These are intended to serve as a standard by which any farmer may check the effectiveness with which he is utilizing his labor and power resources. In addition to time actually spent in the field, allowance has been made for time spent in going to and from fields, adjusting machinery, and making necessary field repairs to harness and equipment; resting teams; during showers; and any other ordinary interference necessarily incident to the operation.

Corn

Usual Practices in Corn Production

Two-thirds of all land for corn is plowed in the fall and one-third in the spring. Fall plowing is preferred, and is practiced as far as time permits, as it relieves the rush of spring work and makes possible earlier seedbed preparation. If wet weather prevents working the land with a disk or spring-tooth harrow to keep down weeds, the land is replowed. During the wet spring of 1922, 50 per cent of all corn land was replowed, but during the five years only about one-fifth of the total corn acreage was plowed twice. Practically all corn land is worked with a disk or a spring-tooth harrow prior to planting. The harrow is used more than the disk. About two-thirds of the land worked with a spring-tooth harrow is gone over twice and the rest once. When the disk is used, 43 per cent of the acreage is gone over once, 41 per cent twice, and the rest more often. The land is all harrowed before planting, 45 per cent two or more times. All planting is done with a two-row horse-drawn planter. Sixty per cent of the corn is checked in hills, the rest is drilled in. Most of the corn land is harrowed after planting, about one-eighth of it twice or oftener. Occasionally a field of corn is blind-cultivated immediately after planting, but cultivation is not ordinarily begun until the corn is above

ground. The average number of cultivations is 4.6. One per cent is cultivated only twice, 8 per cent three times, 38 per cent four times, 38 per cent five times, 13 per cent six times, and 2 per cent seven times. Both single and two-row cultivators are used.

During the period of this study 36 per cent of all corn raised was husked from the standing stalk and an equal quantity put into the silo, there being at least one silo on every farm. Thirteen per cent of the corn crop was husked and shredded; 8 per cent was cut, shocked, and fed in the bundle; 6 per cent was hogged-off; and 1 per cent was fed green. In 1923, when the drouth greatly reduced the yield, 45 per cent of the crop was required to fill the silos, and only 23 per cent was husked standing. There was a tendency during the five years to decrease the amount of corn husked and shredded and to increase the amount fed in bundles and hogged-off. Most of the corn husked standing was husked by hand, altho mechanical pickers were used on several farms.

Materials Used for Corn

The average amount of seed per acre for check corn on all farms is 8.5 pounds. It varies little from farm to farm. The average seeding for drilled corn is 14 pounds per acre, varying from 8 to 25 pounds on different farms. The heavier planting is intended only for fodder or silage. The average amount of twine used is 4 pounds per acre, the range being from 2 to 7 pounds. This variation is due almost altogether to differences in yields.

Standards of Corn Production

The following standards per acre are suggested for corn production. As already stated, the labor rates suggested are based on the accomplishment of farmers who use their labor most effectively. The seed rates are the usual rates in the community, and the amount of twine given is the amount used for a good average crop.

Operation	Equipment	Hours per acre		Acres covered in 10 hours
		Man	Horse	
Plowing	Gang plow and 5 horses	2.0	10.0	5.0
	Sulky plow and 3 horses	3.3	10.0	3.0
Disking	8-foot disk and 4 horses	0.5	2.0	20.0
Spring-tooth harrowing	2-section harrow and 4 horses	0.6	2.4	16.7
Harrowing	22-foot harrow and 4 horses	0.2	0.8	50.0
Planting		0.7	1.4	14.3
Cultivating	Single row cultivator	1.3	2.6	7.7
Cutting	3-horse team	1.6	4.8	6.3
Shocking		3.0	...	3.3
Filling silo		11.0	13.5	...
Husking (standing corn)	1 man with team	7.5	15.0	1.3
Husking and shredding		9.5	12.0	...

Seed for checked corn, 8 pounds per acre
Seed for drilled corn, 15 pounds per acre
Twine, 4 pounds per acre

Distribution of Labor on Corn

In the following table are shown the dates between which the different operations on the corn crop are commonly performed in the locality studied, and the usual days available for the operation. These dates may fluctuate from year to year, but their general sequence is fairly constant. The days available are computed by subtracting from the days in the period all Sundays and holidays and also an estimated number of days on which rain might interfere with the operation. This estimate is based on precipitation records for ten years interpreted in the light of actual rain interference during the five years of this study.

Operation	Dates	Work days available
Spring plowing	April 25–May 25	21
Disking and spring-tooth harrowing	May 5–May 29	18
Harrowing	May 5–June 2	18
Planting	May 9–May 30	14
Cultivating	May 25–July 14	35
Cutting	Sept. 3–Sept. 28	20
Shocking	Sept. 5–Sept. 30	20
Filling silo	Sept. 5–Sept. 22	12
Husking (standing corn)	Oct. 5–Nov. 30	42
Husking and shredding	Oct. 18–Nov. 10	18

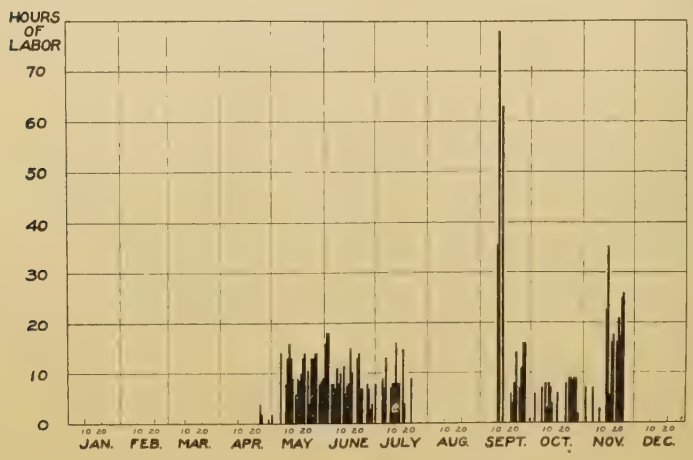

Fig. 10. Distribution of Man Labor by Days on 50 Acres of Corn

The corn crop uses large amounts of labor during May, June, and early July. Silo filling demands much labor for a short period and cutting should be done before or very soon after the first frost, but other harvesting operations may be spread over a considerable period of time.

The dates given do not include the extreme range of time during which the operations were performed, only the most usual period of performance and the time generally found most satisfactory, and can be safely used in planning the farm organization. For any one season adjustments must be made to the weather and seasonal progress of that year.

In Figure 10 is shown the seasonal distribution of labor on 50 acres of corn. Of this, 22 acres were husked standing, 15 were put in the silo, 9 were husked and shredded, and 4 were hogged-off. The steady, heavy labor demand during May was in part due to the fact that much of the corn land was replowed. Planting was begun on May 17 and finished on June 3. About July 1 work on tame hay interfered with corn cultivation, but this was made up later. The silo was filled on September 11, 12, and 14. The later work in September was cutting and shocking corn. Picking up loose ears and husking standing corn were the principal operations during October. Husking was completed during November. Shredding was done November 14 and 15. Except for the rather heavy labor load in May, this labor distribution is representative for the locality.

Oats

Usual Practices in Oat Production

Sixty per cent of the oat land is fall plowed, the rest is seeded without plowing. The land not plowed is usually corn land, and is worked with a disk or spring-tooth harrow in the spring, as is also the fall-plowed land. The unplowed land is usually either double-disked or gone over twice with the spring-tooth harrow. Most of the oat land is harrowed before seeding. One quarter is harrowed twice. Practically all the seeding is done with a three- or four-horse drill. The land is harrowed again after seeding. A seven-foot binder and four horses is the common unit for harvesting, altho on two farms the binder is drawn by a tractor. Shock threshing is the usual practice, altho a few farmers stack their grain each year.

Materials Used for Oats

There is comparatively little variation in rate of seeding. A few farmers use 3 bushels per acre and if the oats are to be used as a nurse crop for alfalfa seeding, 1½ bushels is used, but 2½ bushels is the standard rate. The average amount of twine used per acre is 3⅓ pounds, but this varies from 2 to nearly 5 pounds with varying yields of straw. The cash threshing charges per bushel were 5 cents in 1920, 4½ cents in 1921, 3½ cents in 1922, 3 cents in 1923, and 3½ cents in 1924, including any fuel furnished by the farmer.

Standards for Oat Production

The following standards cover the usual operations in oat production in this locality. The number and combination of these operations may be varied according to soil and weather conditions.

Operation	Equipment	Hours per acre		Acres covered 10 hours
		Man	Horse	
Plowing	Gang plow and 5 horses	2.0	10.0	5.0
	Sulky plow and 3 horses	3.3	10.0	3.0
Disking	8-foot disk and 4 horses	0.5	2.0	20.0
Spring-tooth harrowing	2-section harrow and 4 horses	0.6	2.4	16.7
Harrowing	22-foot harrow and 4 horses	0.2	0.8	50.0
Seeding	10-foot drill and 4 horses	0.5	2.0	20.0
Cutting	7-foot binder and 4 horses	0.8	3.2	12.5
Shocking		1.3	...	7.7
Stacking		3.2	4.5	...
Stack threshing		1.7	0.5	...
Shock threshing		3.2	4.5	...
Seed, 2½ bushels Twine, 3 1/3 pounds				

Distribution of Labor on Oats

In the following table are shown the dates between which the different operations on the oat crop are commonly performed and the usual days available for the operation during the period.

Operation	Dates	Work days available
Spring plowing	April 1–20	15
Disking and spring-tooth harrowing	April 5–25	13
Harrowing	April 5–May 1	19
Seeding	April 10–25	11
Cutting and shocking	July 12–25	11
Stacking	July 25–Aug. 10	12
Stack threshing	Sept. 25–Oct. 15	15
Shock threshing	July 25–Aug. 20	20

Work on the oat crop begins as soon as the ground can be worked in the spring. It is second only to wheat in earliness of planting. The dates suggested above may serve as a general guide in planning the farm operations, but must be adjusted each year to seasonal progress.

In Figure 11 is shown the distribution of man labor on 43 acres of oats. This labor is concentrated during three short periods—10 days of seedbed preparation and seeding in April, 7 days of harvest in July, and 2 days of threshing in August. This distribution is quite representative for the area.

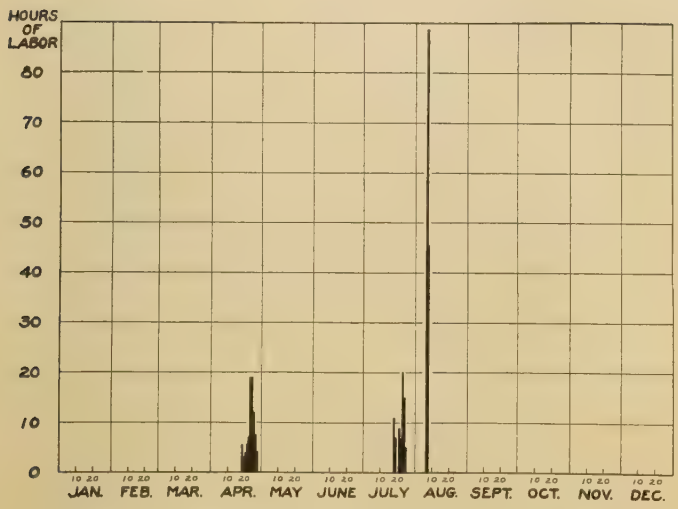

Fig. 11. Distribution of Man Labor by Days on 43 Acres of Oats

The oat crop requires attention during a comparatively limited number of days. This demand, fixed largely by weather conditions, allows little shifting, and the farmer must adjust his labor supply to it.

Barley

Usual Practices in Barley Production

Practically all land for barley is plowed. Two-thirds is plowed in the fall and the rest in the spring. The other operations are approximately the same as for oats.

Materials Used for Barley

The usual rate of seeding barley is 2 bushels per acre. The average twine consumption is 3 pounds per acre, but varies from 1½ to nearly 5 pounds. Barley is ordinarily threshed at the same rate as oats, altho occasionally the rate is half a cent higher per bushel.

Standards for Barley

The labor for barley would be practically the same as for oats. Two bushels of seed and 3 pounds of twine per acre are a fair allowance.

Distribution of Labor on Barley

The distribution of labor on barley is similar to that on oats. The same dates for the operation may be used except that barley matures a little more rapidly than oats and therefore may be sown a little later. It is usually the last of the small grains to be sown in the spring. In Figure 12 is shown the distribution of man labor on 30 acres of barley.

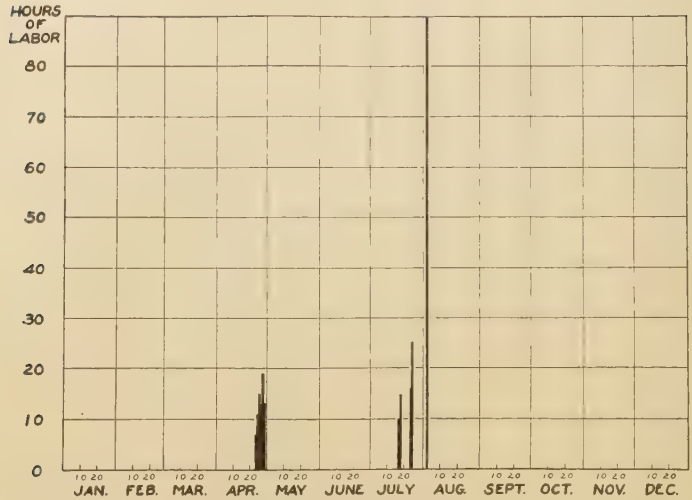

Fig. 12. Distribution of Man Labor by Days on 30 Acres of Barley

Barley is usually planted a little later than wheat or oats, but matures more rapidly, and is ready to harvest as early as any of the spring grains.

Wheat

Usual Practices in Wheat Production

For either winter or spring wheat the land is plowed in the fall and harrowed before planting, about half only once and the rest twice. For spring wheat the fall-plowed land is worked with either a disk or a spring-tooth harrow before planting. All wheat is sown with a drill. Other operations correspond quite closely to those for oats.

Materials Used for Wheat

The rate of wheat seeding varies from 1¼ to 2 bushels per acre; 1½ bushels is the most common rate with 1¾ next in frequency. The average amount of twine is 2¾ pounds per acre. The average threshing cost per bushel was 10½ cents in 1920, 7 cents in 1921 and 1922, and 5½ cents in 1923 and 1924.

Standards for Wheat Production

The labor rates for wheat are practically the same as for oats. The only difference is in the operations performed, which would vary for spring and winter wheat. One and a half bushels of seed and 2¾ pounds of twine should be allowed per acre.

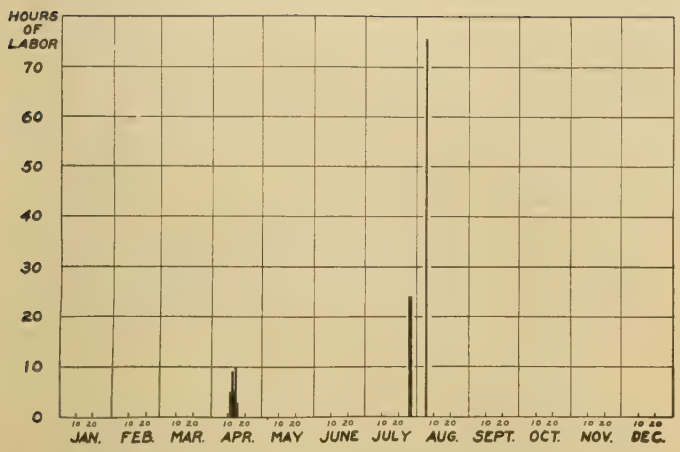

Fig. 13. Distribution of Man Labor by Days on 17 Acres of Spring Wheat

The distribution of labor on spring wheat resembles very closely that on oats and barley.

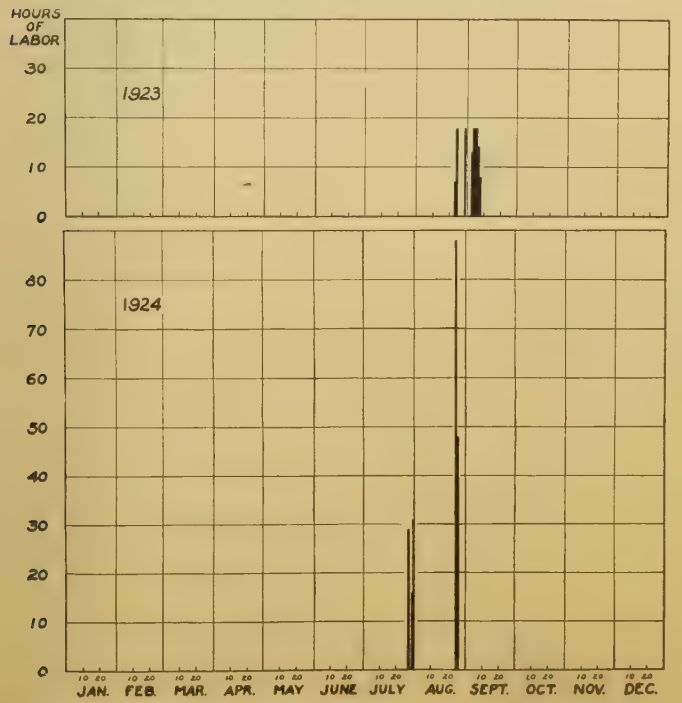

Fig. 14. Distribution of Man Labor by Days on 24 Acres of Winter Wheat

The winter wheat crop contributes to a more uniform season distribution of labor by avoiding the rush of spring seeding and distributing harvesting operations over a longer period.

Distribution of Labor on Wheat

The statement as to the usual time of performing the various operations on oats applies equally well to spring wheat. Spring wheat is the first crop planted in the spring and every effort is made to get it in as soon as the ground can be worked. Winter wheat is usually sown during the first half of September and is ready to cut about a week in advance of the spring-sown grains.

Figure 13 shows the distribution of man labor on 17 acres of spring wheat and Figure 14 on 24 acres of winter wheat. The proportionately smaller amount of labor for spring wheat is due to the fact that the land was plowed the previous fall and the labor does not appear here. All the plowing labor for the winter wheat is shown in the graph. The distribution of the fall work for winter wheat is representative for the crop in this locality. However, the harvesting operations are at least ten days later than normal. This graph is for 1924, when the harvest season was from 10 to 14 days later than normal. Winter wheat conflicts with silo filling and corn cutting, but relieves the rush of spring work and distributes the harvest over a little longer time.

Small Grain Mixtures

Two small grain mixtures commonly grown in this area are oats and barley and wheat and oats. The latter mixture is generally termed succotash. Altho barley ripens rather earlier than oats, by using an early variety of oats it is possible to secure a fairly even ripening. Cultural practices are about the same as for the same crops grown separately. From 2¼ to 2½ bushels of the mixture—half and half by weight of oats and barley—is the common rate of seeding. Succotash is sown at rates varying from 1½ to 2½ bushels per acre. The mixture varies from 32 to 80 per cent of wheat by weight. The most common seeding is 1 bushel of wheat and 1 of oats per acre. The average amount of twine used for either oats and barley or succotash is 3 1/3 pounds per acre, the same as for oats alone. Oats and barley are usually threshed at the same rate per bushel as oats alone, and succotash approximately one cent per bushel higher.

The standard labor rates for oats may be adapted to the mixed crops. The distribution of labor corresponds to that on the separate crops.

Fall Plowing

Attention was called to the fact that most of the plowing for corn and small grains was done the previous fall. Consequently the labor for the operation does not appear in the graph showing the seasonal distribution of labor. Figure 15 shows a representative distribution of man labor on 77 acres of fall plowing. The largest amount of the fall plowing is done in August after shock threshing and before silo filling. The rest is fitted in with the corn harvest.

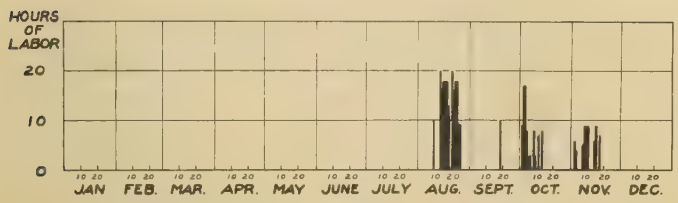

Fig. 15. Distribution of Man Labor by Days on 77 Acres of Fall Plowing

Early fall plowing is desirable from the standpoint of killing weeds. Fall plowing commences immediately after the grain fields are cleared and is fitted in around the threshing and corn harvesting operations.

Tame Hay

Tame hay, as the term is used here, includes red clover, alsike, timothy, and mixtures of these crops, usually a mixture of timothy and clover. Tame hay is seeded with small grain, either by mixing the seed in the drill box or by the use of a special attachment to the drill. Practically no labor is required in addition to that necessary for small grain seeding. If a clear seeding of clover is made, hay is cut only one year; if timothy is added, hay is cut the second and sometimes the third year or else the field is pastured the second or third year. Two cuttings of hay are made on about a fourth of the tame hay land. A second cutting is made for seed on a small acreage. The balance is usually pastured after the first cutting.

Practically all of the tame hay is raked into windrows and picked up with a hay loader or bunched with a rake and pitched on the wagon by hand. Considerable use is made of the side delivery rake. A small amount of hay is tedded before raking and some is cocked by hand. Practically all the tame hay is hauled directly from the field to the barn and unloaded into the mow with either a hay fork or slings. On fields distant from the farmstead the hay is sometimes stacked. The hay is hauled to the stacks with wagons and pitched off by hand. Too little stacking is done to justify the purchase of stackers.

Amounts of Grass Seed Used

The average amount of seed used per acre when clover is seeded alone is 10 pounds. For a mixture of timothy and clover, 3 2/5 pounds of timothy and 8 4/5 pounds of clover are used. This is sufficient for a good stand under ordinary conditions. Lighter seedings often result in a thin stand and there is little advantage in heavier seedings. Hot, dry summers, such as in 1923, are unfavorable for clover or grass seeding and result in a large percentage of loss irrespective of the rate of seeding.

Standards per Acre for Tame Hay

Operation	Equipment	Hours per acre		Acres covered in 10 hours
		Man	Horse	
Mowing, 1 cutting.....	5-foot mower and 2 horses.....	1.0	2.0	10
Raking, 1 cutting.....	10-foot rake and 2 horses.....	0.5	1.0	20
Hauling and stacking, 1 cutting (1½ tons yield)	.....	4.5	6.0	..
Seed—Clover, 10 pounds				
Mixed, clover 8 pounds, timothy 4 pounds				

Distribution of Labor on Tame Hay

The harvesting period for tame hay ranges from the last week in June to the second week in July, according to the season. Clover is usually cut somewhat earlier than timothy or timothy and clover mixtures. Ordinarily the period of hay making is not more than two weeks, during which approximately ten days are available for hay making. Delay in cutting after the hay reaches the proper stage of maturity results in considerable loss in quality. The time for the second cutting of tame hay varies more than for the first, but is usually between August 20 and September 10, altho it is sometimes delayed until later in September.

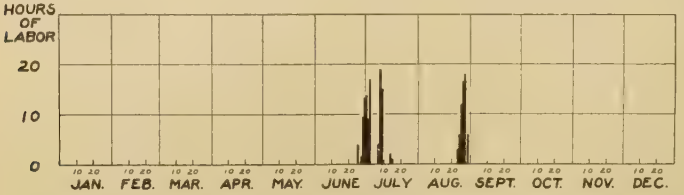

Fig. 16. Distribution of Man Labor by Days on 23 Acres of Tame Hay

Tame hay demands large quantities of labor for a short period of time. The first cutting competes with corn cultivation for the farmer's time and the second in a much less significant degree with fall plowing and silo filling.

In Figure 16 is shown the distribution of man labor on 23 acres of tame hay. A second crop was cut on the entire acreage. The seasonal distribution of labor on tame hay is fixed within rather narrow limits by weather conditions and they can be shifted but little without sacrificing the quantity or quality of the hay produced.

Alfalfa

Usual Practices in Alfalfa Production

During the earlier years of this study alfalfa was seeded alone. The land was plowed in the spring and worked with a disk or spring-tooth harrow during the summer to keep the weeds down. The alfalfa was seeded early in August. Usually the land was limed and the seed

inoculated. In more recent years the seed has been sown with small grain as a nurse crop. Practically as satisfactory results have been obtained without losing the use of the land for a year.

The practices in putting up alfalfa hay are very similar to those described for timothy and clover. More use is made of the side delivery rake and a larger proportion of the crop is turned over with a tedder. More of the alfalfa is cocked by hand. Practically all the alfalfa is hauled into the barn. Two cuttings are made on the entire acreage and in most cases three. Sometimes the third crop is pastured. If the second cutting is rather late, no third cutting is taken off.

Seeding Rates for Alfalfa

The average rate of seeding alfalfa is 11⅓ pounds per acre, varying from 8 to 17 pounds. In later years seeding was slightly heavier. Twelve pounds per acre is enough in most cases.

Standards per Acre for Alfalfa Hay

These rates were computed for a yield of 3½ tons per acre. No allowance is made for tedding or cocking, as these operations are performed so irregularly. About one half of a man hour and one horse hour may be allowed if the alfalfa is tedded and one to two man hours per acre for cocking.

Operation	Equipment	Hours per acre		Acres covered in 10 hours
		Man	Horse	
First cutting				
Mowing	5-foot mower and 2 horses	1.0	2.0	10
Raking	10-foot rake and 2 horses	0.5	1.0	20
Hauling		4.5	5.5	..
Second cutting				
Mowing		1.0	2.0	10
Raking		0.5	1.0	20
Hauling		3.2	4.5	..
Third cutting				
Mowing		1.0	2.0	10
Raking		0.5	1.0	20
Hauling		2.5	3.0	..

Distribution of Labor on Alfalfa

There is a wide variation in the time of cutting alfalfa. In some years the first crop is cut the first week in June and in others not till the third week. Even wider variations occur in the second and third crops. If only two crops are cut, both cuttings are somewhat later than if there are three cuttings. The most common dates for each of the cuttings and the days available during the period are indicated below.

First cutting	June 12 to June 23	7 days
Second cutting	July 13 to July 28	10 days
Third cutting	September 1 to September 24	14 days

Figure 17 shows the distribution of man labor by days on 11½ acres of alfalfa cut three times. The first and third cuttings interfere with work on the corn crop and the second cutting with small grain harvest. Because of the high value per ton of alfalfa hay and its importance in the dairy ration on these farms, alfalfa takes precedence over other crops and the labor organization is so adjusted as to make the labor available when necessary even at some sacrifice on other crops.

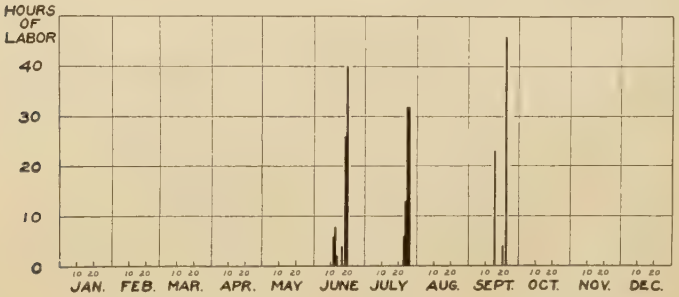

Fig. 17. Distribution of Man Labor by Days on 11½ Acres of Alfalfa Hay
Alfalfa demands large quantities of labor for short periods of time. It competes for the farmer's time during corn cultivation, small grain harvest, and corn harvest.

Wild Hay

Wild hay is not an important crop on these farms. It is grown largely on low land which is too poorly drained to produce other crops satisfactorily. It is handled very much as is tame hay, but is usually cut later, when the weather is more favorable for curing. It is seldom cocked or tedded, as it is less easily damaged by rain than tame hay. The time of cutting varies from late June to October, altho most of it is cut between June 24 and July 28. Wild hay deteriorates less rapidly after it is ready to cut than the tame grasses, hence it is possible to shift the time of cutting considerably in order to avoid conflict with more pressing work.

Use of Unit Expenditure and Labor Distribution Data in Planning a Cropping System

The actual expenditure of labor and materials per acre varies widely from farm to farm. This is evident from the foregoing discussion of crops and from a study of the crop labor tables in the appendix. Low labor expenditures are usually associated with large implements; large power units; experienced, able-bodied workers; balanced power and equipment units; large fields conveniently located; and careful planning of the labor program to avoid loss of time between tasks.

A farmer using the standards in planning a labor program should make allowances for his inability to use any of these methods of labor economy.

The suggested dates for the various crop operations indicate the sequence of the operations rather than exact dates for any given year. Each year's operations are speeded up or retarded according to the season. These data, with the labor distributions, indicate the competition between the several crops for the farmer's time at different periods of the year. The days available represent the maximum time that may be safely depended on for any particular operation. By computing the total labor for the acreage of crops planned and comparing it with the days available, the farmer can determine whether his labor supply is sufficient to meet the demands at all times or whether he must either change his plan or hire additional labor to handle the peak loads.

Relation of Miscellaneous Labor to Crop and Livestock Labor

Classification and Description of Miscellaneous Labor

The labor data presented thus far include only field labor on crops and direct labor on livestock. In addition, on every farm there is more or less indirect labor on both crops and livestock as well as a considerable amount of miscellaneous or maintenance work pertaining to the farm as a whole. For the purpose of this study this miscellaneous labor is divided into manure hauling, miscellaneous or other work on crops and on livestock, and maintenance labor.

Manure hauling.—Approximately 20 per cent of the crop area on the farms studied is manured each year, the average rate of application being slightly less than 10 loads per acre. There is a considerable range in size of loads, the average being approximately 75 bushels, weighing slightly more than a ton. Sixty per cent of this manure is hauled between November 1 and May 1, when most of the stock is in the barn. The custom on many farms is to haul out the manure each day. About the same quantity is hauled out each of these six months, 19 per cent being hauled in May. As most of the manure was applied to land to be planted to corn, this work represents the hauling out of the winter's accumulation to be plowed under for corn. Little manure is hauled during June, July, September, and October. Most farmers clean up their yards in August in the interval between shock threshing and silo filling. Except in May, manure hauling does not seriously interfere with direct labor on crops. Table XII shows the hours of man labor and horse work spent in manure hauling, with other significant facts regarding the operation.

TABLE XII

MANURE HAULING, 1922

Farm No.	Crop acres per farm	Animal units per 100 crop acres	Hours of labor		Loads hauled	Acres covered	Hours per acre		Loads per acre	Per cent of crop acreage covered
			Man	Horse			Man	Horse		
36	93	30	106	280	50	5	21.0	56.0	10.0	5.4
6	121	36	207	437	140	13	15.9	33.6	10.8	10.7
27	100	37	94	272	116	12	7.8	22.7	9.7	12.0
29	98	33	211	437	130	12	17.6	36.4	10.8	12.3
20	131	35	126	376	185	18	7.0	20.9	10.3	13.7
5	154	28	279	762	256	28	10.0	27.2	9.1	18.2
21	269	26	555	1463	515	50	11.1	29.3	10.3	18.6
24	106	35	194	576	231	21	9.2	27.4	11.0	19.8
16	115	43	329	811	242	23	14.3	25.3	10.5	20.0
18	148	36	308	669	305	30	10.3	22.3	10.2	20.3
23	139	27	236	651	341	30	7.9	21.7	11.4	21.6
14	101	39	240	526	242	22	10.9	23.9	11.0	21.8
31	116	33	220	722	277	26	8.5	27.8	10.7	22.4
9	163	28	532	1310	396	37	14.4	35.4	10.7	22.7
26	173	38	340	938	597	40	8.5	23.5	14.9	23.1
12	104	36	350	792	261	26	13.5	30.5	10.0	25.0
25	92	51	217	423	298	23	9.4	18.4	12.9	25.0
10	110	31	257	420	259	29	8.9	14.5	8.9	26.4
28	114	29	312	770	320	32	9.8	24.1	10.0	28.1
1	95	42	291	784	315	27	10.8	29.0	11.7	28.4
15	152	39	375	979	540	50	7.5	19.6	10.8	32.9
35	92	36	453	899	311	31	14.6	29.0	10.0	33.7
Average per farm										
22 farms, 1922	127	34	283	695	288	27	10.5	25.7	10.7	21.3
23 " 1920	128	32	281	704	236	28	10.0	25.1	8.4	21.9
21 " 1921	129	30	313	744	236	24	13.0	30.8	9.8	18.6
22 " 1923	130	34	276	673	316	31	8.9	21.7	10.2	23.8
23 " 1924	129	33	261	603	218	21	12.4	28.7	10.4	16.3

Miscellaneous crop labor.—The hours of labor used for crops, as considered in the previous discussion and as presented in the appendix, include only direct field work on these crops. They do not include the labor expended in cleaning and treating seed; purchasing seed, twine, and other materials; cleaning and grading market grain, baling hay and straw; or marketing crops. As only a small amount of the crops is sold from these farms, the amount of this type of labor is small. On one farm it was 18 per cent of the total field labor on crops, but the average was only 3.33 per cent of the man labor and 1.25 per cent of the horse work used for field work. Tables XIII and XIV show the amount of this type of work for each farm in 1922 and the average of all farms for each of the five years.

Miscellaneous livestock labor.—The livestock labor presented in the previous sections includes only the direct work on each class of stock—the regular daily care of the stock and such irregular work as buying and selling, caring for sick animals, and other labor directly chargeable to a specific class of stock. In addition to this, considerable time is spent on each farm in grinding feed, hauling feed and bedding, and other operations connected with the maintenance of livestock, but which serve several classes of stock jointly. The amount of this labor, as well as of direct labor on livestock is shown in Tables XIII and XIV, for each farm in 1922 and the average for all farms for each year. The man labor of this type is relatively small as compared with the direct labor. It averages less than 3.5 per cent of the direct man labor. The horse work, however, averages 77 per cent of the direct horse work and on many farms exceeds it.

Maintenance labor.—In addition to the man labor and horse work that may be charged directly to the crop and livestock enterprises, a considerable amount of maintenance or upkeep work is essential which can not be charged directly to any enterprise or group of enterprises. This is classified in five groups and the amount of each is shown in Tables XIII and XIV. Real estate labor consists in repair and upkeep of buildings, fences, drains, water systems, lighting plants, etc., as well as any new construction. Under machinery labor is listed time spent repairing machinery and equipment, purchasing repair materials and purchasing new machinery. General expense labor includes trimming trees, mowing lawns, work on public or farm roads, attending farm organization meetings, office work in connection with the farm business, and any other tasks that serve the entire farm organization but can not be allocated directly or indirectly to any specific enterprise. Household labor includes time spent hauling and preparing fuel, purchasing household supplies, and similar tasks commonly performed by the men on the farm. This does not include any routine household tasks, even tho they may have been

performed by the farmer or his hired help. The labor on garden, orchard, and potatoes includes only time spent in producing food for consumption on the farm.

The relative amount of this maintenance labor varies widely from farm to farm, but the average for all farms is fairly constant. The amount is determined in part by the kind and amount of equipment, the kind and arrangement of buildings, the farm and farmstead layout, and similar physical factors, but also to a large extent by personal factors, such as the managerial ability of the operator, his improvement program, and the relations between the home and the farm business. In planning the labor program of a farm, allowance must be made for this maintenance labor in addition to the crop and livestock labor. However, the amount of this labor does not vary directly with the kinds of crops grown or the classes of livestock maintained and can be largely ignored in studying adjustments in the productive enterprises. This type of work is not usually as fixed in point of time as is the regular crop and livestock work. Much of the repair and upkeep work can be shifted to slack periods during the year or even from one year to another. Permanent improvements, as building construction or tiling, may greatly increase this class of work during a given year and special provision must be made in the labor supply to handle them. The larger percentage of this maintenance labor in 1923 was due to the building of houses on two farms and additions to barns on three others.

Planning the Labor Program of the Farm

A representative distribution of labor for each of the important crops and for each class of livestock has been shown, with a statement as to the usual time of performing each of the operations. In Figure 18 these dates are so combined as to indicate the periods of competition between crops. These the farmer must know if he is to avoid an undesirable piling up of labor at certain periods. It is his problem so to adjust his cropping plan as to reduce these conflicts to a minimum and yet provide as regular and continuous a succession of crop labor throughout the season as is possible.

The crop labor demands are distinctly seasonal and there are frequent periods of competition between crops. The exact date for any given operation may vary from year to year, but the general sequence is the same. Livestock, on the other hand, requires labor throughout the year and in fairly constant quantities for considerable periods of time. For most classes of stock this demand is constant through the year. The competition for labor between different classes of stock is often not so important as the competition for feed, pasture, and building equipment.

TABLE XIII

DISTRIBUTION OF TOTAL MAN LABOR ON FARMS, 1922

Farm No.	Crop acres per farm	Animal units per farm	Real estate hrs.	Machinery hrs.	General expense hrs.	Household hrs.	Garden, potatoes, orchard hrs.	Total maintenance hrs.	Livestock		Crops		Total man labor on farm hrs.	Per cent maintenance labor of total
									Chore hrs.	Other hrs.	Field hrs.	Other hrs.		
36	93	28	195	319	220	338	360	1432	2518	75	1123	201	5349	26.8
27	100	37	107	29	20	135	8	299	3956	107	1332	4	5698	5.2
29	98	32	232	117	83	87	43	562	4742	174	1833	19	7330	7.7
35	92	33	189	269	109	275	96	938	4212	139	2172	143	7604	12.3
6	121	44	172	216	475	160	13	1036	4468	406	1592	111	7613	13.4
31	116	38	257	104	77	140	130	708	4586	92	2219	45	7650	9.3
14	101	39	126	35	132	192	130	615	5248	74	1842	35	7814	7.9
24	106	37	279	95	42	74	55	545	5213	147	1978	32	7915	6.9
23	139	37	302	209	49	138	69	767	4742	74	2406	12	8001	9.6
18	148	53	109	47	43	281	98	578	4760	180	2595	39	8152	7.1
12	104	37	169	72	65	154	14	474	5109	138	2361	70	8152	5.8
28	114	33	110	104	57	133	13	417	5341	102	2365	27	8252	5.1
1	95	40	275	112	101	442	141	1071	4973	217	1982	49	8291	12.9
10	110	34	328	57	44	324	87	840	5525	69	2064	20	8518	9.9
5	154	43	673	473	179	146	337	1808	4413	221	2318	97	8857	20.4
25	92	47	457	284	63	52	115	971	5940	219	1734	47	8911	10.9
20	131	46	297	401	249	279	143	1369	6282	211	2014	52	9928	13.8
16	115	49	369	156	154	231	260	1170	5917	145	2689	69	9990	11.7
15	152	59	345	161	130	330	18	984	5481	364	3253	40	10122	9.7
26	173	66	544	232	75	125	41	1017	7038	227	2979	64	11325	8.9
9	163	45	205	263	31	137	364	1000	7293	198	3541	219	12251	8.2
21	269	69	567	192	305	255	142	1461	10237	216	4021	67	16002	9.1
Averages														
22 farms, 1922	127	43	287	179	123	201	122	912	5363	172	2292	66	8805	10.4
23 " 1920	128	41	386	115	98	184	103	886	4792	177	2431	81	8367	10.6
21 " 1921	129	39	344	198	79	214	143	978	5274	171	2257	78	8758	11.2
22 " 1923	130	44	496	155	167	165	174	1157	5172	192	2053	90	8664	13.4
23 " 1924	129	43	259	152	214	173	65	863	4776	162	2317	67	8185	10.5

TABLE XIV

DISTRIBUTION OF TOTAL HORSE WORK ON FARMS, 1922

Farm No.	Crop acres per farm	Animal units per farm	Real estate hrs.	Machinery hrs.	General expense hrs.	Household hrs.	Garden, orchard hrs.	Total maintenance hrs.	Livestock		Crops		Total horse work on farm hrs.	Per cent maintenance work of total
									Chore hrs.	Other hrs.	Field hrs.	Other hrs.		
36	93	28	58	36	68	114	708	984	303	64	4406	244	6001	16.4
27	100	37	77	18	8	94	21	218	106	75	3068	8	3475	6.3
29	98	32	98	..	31	35	28	192	89	207	3221	22	3731	5.1
35	92	33	45	12	40	141	99	337	189	251	4274	61	5112	6.6
6	121	44	100	70	817	178	14	1179	624	352	2786	127	5068	23.3
31	116	38	55	11	50	58	113	287	166	67	4674	29	5223	5.5
14	101	39	23	4	122	61	70	280	136	111	3879	14	4420	6.4
24	106	37	80	4	8	64	44	200	116	108	3955	..	4379	4.6
23	139	37	70	..	18	38	68	194	170	48	4435	..	4847	4.0
18	148	53	43	..	10	128	74	255	354	243	5634	12	6498	3.9
12	104	37	98	4	60	106	23	291	218	204	4968	72	5753	5.1
28	114	33	18	3	10	62	11	104	138	172	4870	10	5294	2.0
1	95	40	44	2	38	207	170	461	230	360	4465	15	5531	8.3
10	110	34	107	2	32	442	39	622	211	86	4636	10	5565	11.2
5	154	43	127	21	49	134	367	698	223	354	3817	38	5130	13.6
25	92	47	50	..	..	52	100	202	200	356	3477	18	4253	4.8
20	131	46	68	106	226	298	44	742	278	159	5324	24	6527	11.4
16	115	49	61	..	20	31	253	365	112	197	5271	77	6022	6.1
15	152	59	62	6	122	113	14	317	298	194	6178	24	7011	4.5
26	173	66	98	8	42	37	58	243	127	170	7631	36	8207	2.9
9	163	45	22	14	52	34	228	350	197	38	8165	118	8868	3.9
21	269	69	49	..	177	217	60	503	330	216	6622	17	7688	6.5
Averages														
22 farms, 1922	127	43	66	15	91	120	118	410	219	183	4807	44	5663	7.2
23 " 1920	128	41	173	18	59	132	74	456	291	229	3980	67	5023	9.1
21 " 1921	129	39	101	20	56	129	100	406	266	169	4408	59	5308	7.6
22 " 1923	130	44	108	17	106	94	195	520	186	241	4451	46	5444	9.6
23 " 1924	129	43	78	14	113	103	49	357	379	205	4674	59	5674	6.3

The main problem in planning the labor program of the farm is so to combine the crop and livestock enterprises that the total labor expended on them, when increased by the necessary miscellaneous labor, will be so distributed throughout the year as to make the fullest and most effective use of available labor.

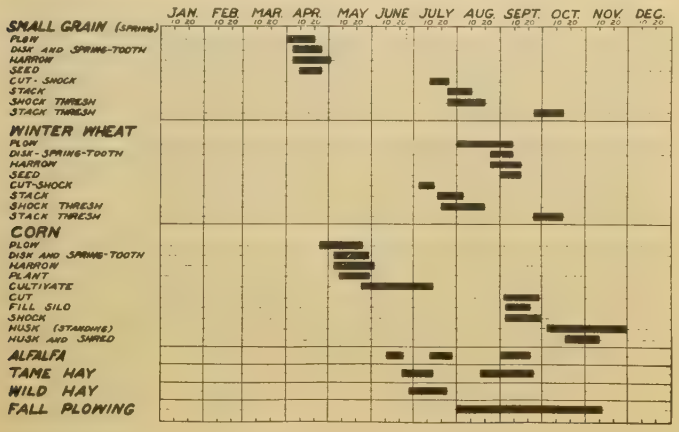

Fig. 18. Usual Period for Performance of Field Crop Operations in Steele County

Different crops use the farmer's labor at different periods during the year. The small grain crops conflict with each other, but interfere little with corn. The hay crops conflict little with each other, but all compete at some period with the corn crop.

Day-to-day management of labor.—In addition to the general problem of so adjusting the crop and livestock enterprises as to secure a desirable seasonal distribution of labor, the farmer must work out the details of his labor program from day to day. Such tasks as feeding and caring for livestock must not only be performed every day, but at certain rather definite times. Many crop operations, such as seeding and harvest, are almost as fixed, but owing to seasonal variations can not be as definitely planned for in advance. Such other work as hauling manure, repairing buildings and fences, and marketing non-perishable products, may be shifted about considerably according to the press of other work.

Weather must also be considered in laying out the tasks for a particular day. Some work can be done when it is raining, other work when the ground is wet but rain is not actually falling. Other work requires freedom from both rain and wet soil. Likewise, some tasks can be performed only when the ground is thawed, others when the ground is frozen but free from snow, and still others when the ground is both frozen and covered with snow. In the day-to-day management of labor the farmer should give tasks preference according

to their time fixity and their relation to weather conditions.[3] Work that can be shifted about should be used to fill the gaps between tasks whose time of performance is relatively fixed. The actual working out of this on a 208-acre farm is shown in Figure 19. This represents a desirable adjustment of fixed and shifting labor. Under "fixed labor" are included livestock feeding and care and field crop work which must be done at a specific time or can vary only within narrow limits. In "shifting labor" are included all tasks that can be shifted freely within seasonable limits or even throughout the year. Most of the shifting labor is performed during the winter. Shifting work during the crop season is done largely on rainy days or between the important crop operations. In this way the labor distribution is fairly uniform throughout the year.

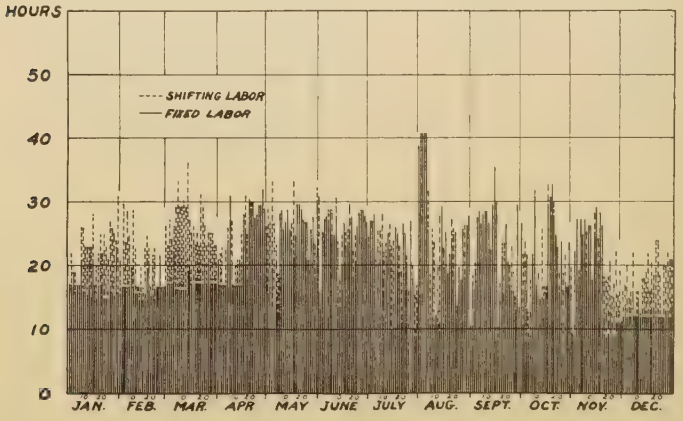

Fig. 19. Day-to-day Adjustment of Fixed and Shifting Labor on a 208-Acre Farm

Seasonal tasks should be performed when conditions are most favorable. Other work that can be done at any time should not be allowed to interfere with them, but may be fitted in at slack periods so as to secure a fairly uniform distribution of labor for the year.

Exchange labor.—Such operations as threshing and silo filling require large amounts of labor for from one to four days. Even the most careful adjustment of enterprises and the best balanced day-to-day planning can not obviate these peak loads. To hire this extra labor would be expensive. Often it is not available. The customary method of meeting these peak demands in this area is through exchange labor between farms, as illustrated in Figure 20. There were four periods during which the regular labor supply was inadequate to meet

[3] For a fuller discussion of this point see Minn. Agr. Exp. Sta. Bul. 205.

the peak demands—threshing in August, silo filling in September, flax threshing in October, and corn shredding in November. By means of exchange labor the peak load of these 8 days was spread over 40 days and thus was handled with the regular force.

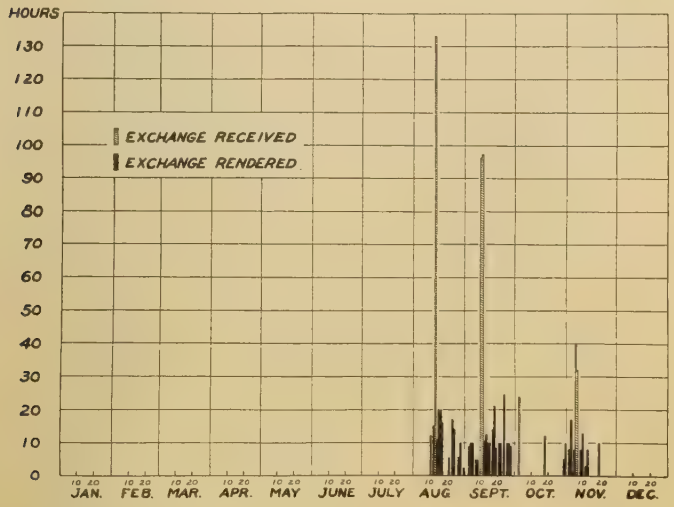

Fig. 20. Exchange Labor on a 220-Acre Farm

By exchanging labor with their neighbors, farmers are able to avoid hiring extra help for threshing, silo filling, and other tasks demanding large amounts of labor for short periods.

Tractor Work

Tractors are used on more than half the farms studied, but are seldom used exclusively for any one operation. In presenting the amounts of labor used for various crop operations, both horse and tractor work are reported for the same operation on farms where tractors are used. The average in most cases includes some tractor work. The common practice of using both tractor and horses in the same field and for the same operation makes it impossible to compute separate rates, and difficult to study the range of labor expenditures between farms, particularly as the size of tractor varies as well as the extent of its use. The standards presented are all computed in terms of horse work. If these are to be applied on farms where tractors are used, allowance must be made for any saving in man labor as well as for the substitution of tractor for horse work.

TABLE XV

AMOUNT AND KIND OF TRACTOR WORK DONE, 1920

Farm No.	Size of tractor	Crop acres	Drawbar					Belt				Custom			Total tractor work hrs.
			Plowing hrs.	Seedbed preparation hrs.	Cutting grain hrs.	Miscellaneous hrs.	Total hrs.	Grinding feed hrs.	Sawing wood hrs.	Silo filling, threshing, shedding hrs.	Total hrs.	Drawbar hrs.	Belt hrs.	Total hrs.	
35	3-plow	91	85	32	..	12	129	..	..	24	24	4	..	4	157
31	2-plow	117	138	43	..	10	191	20	9	41	70	..	15	15	276
3	2-plow	113	166	88	..	..	254	..	..	18	18	..	14	14	286
28	3-plow	115	168	32	..	..	200	..	..	53	53	..	64	64	317
12	3-plow	97	148	101	..	..	249	..	8	46	54	..	38	38	341
*	3-plow	219	208	38	18	7	271	60	14	15	89	..	10	10	370
32	2-plow	164	164	51	..	6	221	33	2	142	177	..	..	..	398
6	2-plow	120	141	151	..	..	292	51	..	24	75	..	43	43	410
5	4-plow	182	102	97	110	13	322	..	6	59	65	..	28	28	415
15	3-plow	152	193	100	..	12	305	38	23	22	83	22	36	58	446
37	2-plow	224	137	24	35	..	196	12	..	38	50	173	33	206	452
33	2-plow	128	241	108	..	9	358	39	16	47	102	..	..	..	460
21	3-plow	253	194	144	52	16	406	46	..	42	88	..	..	..	494
9	2-plow	172	324	163	83	96	666	88	10	51	158	..	10	10	834
Averages															
14 tractors,	1920.....	153	172	84	21	13	290	28	7	44	79	15	20	35	404
12† "	1921.....	159	119	48	16	6	189	40	4	50	94	1	7	8	291
12† "	1922.....	133	105	41	4	11	161	27	3	36	66	..	13	13	240
11‡ "	1923.....	146	75	41	8	12	136	30	2	38	70	..	23	23	229
11§ "	1924.....	136	63	30	7	6	106	42	6	31	79	..	44	44	229

* Owned and used co-operatively by two farmers.

† Includes three 2-plow, eight 3-plow, and one 4-plow tractors.

‡ Includes three 2-plow, seven 3-plow, and one 4-plow tractors.

§ Includes two 2-plow, eight 3-plow, and one 4-plow tractors.

Some idea of the extent of tractor use and the kind of work done is presented in Table XV. Data for each farm for 1920 are given and averages for the succeeding years. The year 1920 was selected because of the larger use of tractors that year. High prices for horse feeds as compared to prices for tractor fuel are an important factor in causing the large use of tractors in 1920. As feed prices declined, tractor use fell off sharply. The use of the tractor for field operations as a substitute for horses also steadily declined. The amount of belt work remained fairly constant and the custom work tended to increase. Considerable employment is provided for tractors by feed grinding, silo filling, and corn shredding, even tho they are not used for field operations.

PART III. APPLICATION OF UNIT EXPENDITURE AND LABOR DISTRIBUTION DATA TO ORGANIZATION OF FARM BUSINESS

Principles of Choice and Adjustment of Enterprises Affecting Factors

The basic data presented thus far are useful in planning a farm organization that will more effecively utilize the resources within the farmer's control. Before illustrating the methods of their use, some attention should be given to the general principles of choice and adjustment of enterprises.

In deciding the kind and acreage of crops to be grown and the kind and numbers of livestock to be maintained, the following general considerations must be kept in mind:

1. The adaptation of the enterprise to conditions in the area.
2. The varying demands of the several enterprises on the resources of the farmer.
3. The inter-relations between enterprises.
4. The possibilities for utilizing relatively fixed resources in the farmer's possession.
5. The facility with which enterprises lend themselves to shifts.
6. Changes in prices of products or in prices of cost factors.

Area Adaptation of Enterprises

In such an old settled area as Steele County, the adaptation of the various crops has been well worked out and only those adapted to the region are retained. The history and development of cropping systems have been discussed in Part I. The principal problems of this kind that may arise in Steele County concern new varieties of crops developed or new species introduced. Minturki wheat (winter) is a new variety

introduced during the period of this study that apparently has demonstrated its adaptability and yielding power. Alfalfa is a new species that has become established during the same period.

Disease and insect problems also may arise which affect the quality as well as the quantity and certainty of yields. However, there are at present no problems of this type affecting any of the important crops produced in this area. Marketing facilities are also a factor in area adaptation but, as has been pointed out, Steele County has adequate marketing facilities.

Variations in Use of Farmer's Resources by Different Enterprises

It has been noted that widely differing amounts of labor are used by the various crops and livestock and that the seasonal distribution varies widely. Small grain requires large amounts of labor for relatively short periods at seed time and harvest. Corn, on the other hand, requires more labor per acre, but over a much longer time. Small grains require attention at about the same time, but corn and small grain conflict very little with each other. Alfalfa and tame hay conflict little but both compete with corn at certain seasons. Labor requirements on livestock are continuous and fairly constant throughout the year and compete with crops for labor throughout the season. The amount of labor required by different classes of stock varies greatly, dairy cows requiring large amounts of labor continuously throughout the year, and hogs comparatively little.

All crops compete with each other for land. Crops use relatively large amounts of machinery and equipment, whereas livestock, particularly dairy cows, require relatively more outlay for shelter. Different classes of livestock need different kinds of feeds as well as different amounts. Cattle, sheep, and horses use considerable quantities of pasture and roughage, while swine and poultry use little but concentrates. All these peculiarities must be considered and given due weight in planning a well-balanced farm organization.

Enterprise Inter-relations

Enterprises compete with each other for the use of the farmer's resources, as has been pointed out. They also complement and supplement each other. Two enterprises are said to be complementary when one contributes to the production of the other. Feeding crops and livestock are complementary in that the crops contribute feed to the stock and the stock contribute manure to stimulate crop production. By-products of one enterprise can be used advantageously by the other. The skimmilk produced by the dairy herd is a valuable protein supplement for swine and poultry. This use of the non-marketable by-

products of one enterprise by another is a common inter-enterprise relation in farming and is an important factor in determining enterprise combinations.

An enterprise is said to be supplementary to another when it enables the farmer to make fuller utilization of the labor, horse power, equipment, land, and other resources used in the production of the other enterprise. The farmer who raises only wheat is very busy for short periods of time, but has little to do the rest of the year. The addition of corn to the cropping system will furnish steadier employment for the farmer and his horses and more use for his equipment.

Certain enterprises may be directly competing at certain times of the year and not compete at other times. They may be both complementary and supplementary. These inter-relations can not be definitely stated or accurately measured. They introduce some very complex difficulties in farm enterprise accounting. They must, however, be recognized and reckoned with in combining and adjusting enterprises.

Utilizing the Farmer's Fixed Resources

The labor force of the farm, so far as it consists of the farmer and his family, is a more or less fixed resource. An enterprise or combination of enterprises that will furnish this labor supply the fullest employment consistent with their personal well being is likely to produce the largest net farm income, even tho the return from some is low. A low return is better than none. The same principle holds with regard to buildings. It may not pay to erect a barn to shelter a certain class of stock, but once the barn is erected the farmer may find it profitable to raise this class of stock as long as they can pay rent for its use over the current upkeep cost due to use. Many farm investments of this type can not be readily converted to other uses. For a given farm they are important factors in determining the line of production.

Facility with Which Enterprises Lend Themselves to Shifts

There is a wide variety in the fixity, as well as in the amount, of investment required for different enterprises and also in the time required to establish the enterprise. Most crops have an annual cycle. The farmer may plant all his small grain land to wheat one year and then shift to oats or barley the following year with no material change in investment. Except where large amounts of special equipment are needed, shifts between the annual crops are generally made rather easily. The production cycle in livestock, however, is much longer and shifts are much more likely to involve loss, particularly with breeding stock. It takes years to develop a high producing dairy herd and constant care in breeding and weeding to maintain it. It takes approximately three years from the time a cow is bred until her offspring can be added to

the producing herd. Perhaps only half the calves will be heifers and these must be culled if quality is to be maintained. This long cycle of production and slow rate of increase is an important factor in the stability of the dairy business, especially in such an area as Steele County, where the farmers raise their own stock and considerable attention is being paid to purebred stock. In beef cattle the rate of turnover is also slow, except in feeding purchased cattle. Swine and poultry, on the other hand, increase rapidly and shifts can be made quickly, except as shelter and equipment are limiting factors. Because of the complementary relation of dairy cows and swine, the swine enterprise tends to be relatively more stable on dairy farms than on others.

Livestock farming involves the seeding down of meadows and pastures. This introduces a longer cycle into crop production and to that extent tends to stabilize the cropping system.

Price Changes

The returns from any farm organization will vary from year to year, because of changes in prices of the cost factors and in prices of farm products. An organization profitable in one year may be decidedly less profitable the next. Prices of farm products vary seasonally and from year to year, and in many cases in fairly definite cycles over periods of several years. In so far as seasonal price variations are fairly constant, marketing may be adjusted to take advantage of them. Changes from year to year, especially in crop prices, may be due to variations in production caused by seasonal conditions. These can hardly be anticipated. Many of the cyclical changes are so regular in extent and duration that the farmer who has the best information available regarding these cycles may make adjustments to take advantage of the changes.

In addition to these periodic fluctuations in prices, in which changes up and down may roughly balance, there may be certain more or less permanent economic changes that may cause a definite trend either upward or downward. The competition of new wheat land in Canada and Argentina may tend to depress the price of wheat for some years. Cheap corn and beef from Argentina may likewise affect the domestic price for these commodities. On the other hand, insects or diseases that affect large competing areas, or added tariff, may so stimulate prices as to insure higher levels for some time in the future.

The policies of farmers in organizing their business to meet changing price conditions vary between two rather wide extremes. Farmers at one extreme have attempted to shift their production with shifting prices. Occasionally a man of unusual foresight and judgment may do this successfully, but the average farmer usually shifts just too

late. He plans next year's acreage in line with this year's price, with the result that if enough other farmers do the same thing price conditions are likely to be reversed. Other farmers go to the other extreme of planning out a definite system of crop and livestock production and follow it fairly rigidly from year to year without much regard to price changes. Probably the safest policy for most farmers to follow would be a modification of the latter plan to allow greater elasticity in the choice and adjustment of enterprises.

At the present time public and private agencies are making extensive studies of the factors that affect prices. The United States Department of Agriculture and the various agricultural experiment stations are making available much information regarding price cycles, conditions of supply and demand, and probable future price and production trends. A plan of farm organization sufficiently elastic to allow some shifting with permanently changed price conditions, as well as with cyclical price changes, so far as the use of the farmers' fixed resources permit these changes, will probably be the most satisfactory from the standpoint of stability of return. The farmer who makes fullest use of all available information regarding price and production trends will be able to keep his farm organization most accurately adjusted to changing price conditions.

Conditions Affecting the Application of Farm Organization Principles to a Specific Farm

That the farmer is dominated by economic motives—that he is seeking the largest possible net return from his business—is assumed in most studies of this nature. It must always be recognized, however, that personal considerations may outweigh the desire for profit, and farmers often forego maximum returns rather than make changes in their organization that affect unfavorably the home and family life or that introduce enterprises or operations that are personally distasteful. It is therefore the purpose of this analysis merely to point out methods by which the farmer may forecast the increase in his net income that will result from specific adjustments in his farm organization. It then remains for him to decide whether this increase is sufficiently large to outweigh any personal objections or inertia that oppose the change.

There are two general types of changes in the farm organization that will affect the farm income. The first includes changes in the kinds or acreage of crops grown and in the kinds and number of livestock maintained. This is sometimes termed the problem of choice and combination of enterprises or of external enterprise relations. The second type deals with methods and practices within a given enterprise. It concerns cultural practices, feeding systems, and husbandry methods. It deals with internal enterprise adjustments and may be termed a study of enterprise efficiency.

In building up a new farm organization or developing a system of farming in a newly settled country, the problems of the first type are by far the more important. They may be relatively more important in crop farming than in livestock production. However, in an old settled county with a comparatively well settled type of farming fairly uniformly followed, as in Steele County, it is probable that enterprise relations have been fairly well worked out. Maladjustments of enterprises are not likely to be especially numerous or serious. On the other hand, the wide range in the amount of labor and materials used indicates a wide range in efficiency in the conduct of specific enterprises. The possibility of increasing the net income of these farms through a realignment of enterprises is undoubtedly much less than through the adoption of improved husbandry practices within the enterprises. The latter may of course involve some changes in the choice and relative size of enterprises; for example, the most profitable dairy production may necessitate an increase in the alfalfa acreage, or the addition of rape or alfalfa pasture may result in economies in swine production. The data that have been presented in this publication are useful in studying both types of problems.

In applying these data it should be remembered that several factors can not easily be measured. Perhaps the most important of these is the managerial ability of the farm operator. In suggesting changes it is assumed that the farmer's efficiency as a producer would remain the same—that he would handle new enterprises or increased enterprises as effectively as he does those he is now conducting. It is entirely possible that increases or decreases in efficiency may result from the proposed changes. This it is impossible to determine. It is believed that this assumption of constant efficiency, except for very radical changes in the farm organization, involves no material error that would seriously detract from the value of the analysis based upon it.

It should be observed that in a fairly uniform and fixed system of farming such as the dairy type in Steele county, the farm business is built up around one or more major enterprises. In this case the dairy is the central enterprise. Next in importance and closely associated with it is the swine enterprise. The cropping system is designed largely to furnish the greatest amount of feed of the kind that these two classes of livestock can use most effectively. Occasionally the feed crops are supplemented by some crop grown for sale, but the feed crops dominate the cropping system.

Use of Unit Expenditure Data in Forecasting Effect of Enterprise Adjustments

General Plan of Application

The following examples will illustrate the use of data presented in Part II in forecasting the effect of specific adjustments on the net return. The general plan used is a method of substitution, or alternatives. The analysis is based on the assumption that in studying enterprise adjustments only the costs and return that will be directly affected need be considered. Such changes as will be proposed do not ordinarily affect overhead costs, land rent, and other fixed charges, at least not materially.

Illustration No. 1. Resources and Present Productive Organzation

The following is a description of the resources and productive organization of a farm as it existed in 1922. Normal crop yields for the locality have been substituted for actual in order to avoid the effect of seasonal variations upon the amount available for feed and sale. Actual livestock production is used. The distribution of the total farm acreage and the normal yield of each crop are given in Table XVI.

TABLE XVI

DISTRIBUTION OF ACREAGE AND PRODUCTION OF CROPS (PRESENT ORGANIZATION)

Real estate and crops	Acres	Yield per acre	Total production
Corn for grain, bu.	33.0	45	1485
Corn for silage, tons	22.5	6½	146
Corn for fodder, tons	3.5	2½	9
Oats, bu.	15.5	45	700
Oats and barley, bu.	45.0	40	1800
Rye, bu.	7.0	15	105
Tame hay, tons	46.0	1¾	81
Wild hay, tons	7.0	1¼	9
Total crop area, acres	179.5		
Pasture (permanent) acres	92.5		
Farmstead and waste, acres	8.0		
Total farm area, acres	280.0		

The buildings were sufficient to take care of 30 cows, 35 young cattle, 15 brood sows and their pigs, and 200 chickens.

The livestock maintained and its production are shown in Table XVII.

TABLE XVII

NUMBER AND PRODUCTION OF PRODUCTIVE LIVESTOCK (PRESENT ORGANIZATION)

Kind of livestock	No. of head	Production
Cows	26	4200 lbs. butterfat
Other cattle	32	
Brood sows	7	17000 lbs. pork
Chickens	75	

The labor supply and the power and equipment utilized under the existing plan of operation are given in Table XVIII.

TABLE XVIII

Labor, Power, and Equipment Supply (Present Organization)

A. Man Labor
   Operator for the entire year.
   One hired man for the entire year.
   One hired man April 1 to December 1.
   Operator's wife, who assisted with dairy utensils.
   Extra help as needed.
B. Power
   Twelve work horses throughout the year.[4]
   A 12-20 tractor, used only for belt work.
C. Machinery
   The farm was fully equipped for the crops grown or proposed.

The distribution of labor on this farm is shown in Figure 21. Only the labor actually performed is included. It does not represent the exact labor accomplished by the farmer and his regular labor supply because exchange labor received is included and that rendered is not. The regular supply of labor, computed on the basis of a normal day's work for each regular worker, is also shown. At practically all times the labor used exceeds the regular supply. The deficit is largely made up by hiring extra help irregularly. To a limited extent the regular workers lengthen their normal working day. Exchange labor is also used to take care of peak loads. In August, when the labor used was less than the supply, much time was spent by the regular workers on exchange work for neighbors. A similar comparison of horse work supply and utilization is not necessary, as the supply at all times exceeded the amount used.

The following prices are used in the computations of cost and income on this farm: wheat $1.20 per bushel; butterfat 50 cents per pound; pork 8 cents per pound. They represent, as nearly as can be estimated, a normal relation between prices. In making such a computation the farmer should have the best information available regarding the probable trend of prices.

The labor rates for crops which will be affected by the adjustments proposed are shown in Table XIX. The material costs for crops are given in Table XX. These are the actual rates on this farm and may be considered normal.

[4] Besides supplying power, the work horses produce several colts annually. Six unbroken colts are kept.

TABLE XIX

HOURS OF LABOR PER ACRE FOR CROP PRODUCTION

	Man	Horse		Man	Horse
Wheat and rye			Corn		
Plowing	2.0	12.0	Plowing	2.1	11.4
Seedbed preparation	1.7	6.5	Seedbed preparation	3.6	14.1
Seeding	0.7	2.6	Planting	0.7	1.4
Cutting	0.8	3.2	Cultivating	7.6	15.2
Shocking	2.0		Husking	8.4	16.8
Stacking	3.3	4.8	Alfalfa		
Threshing	1.9	1.2	1st cutting	5.5	10.5
Marketing	1.0	2.0	2nd cutting	5.0	9.5
Tame hay, 1st cutting	5.2	10.4	3rd cutting	4.5	9.0

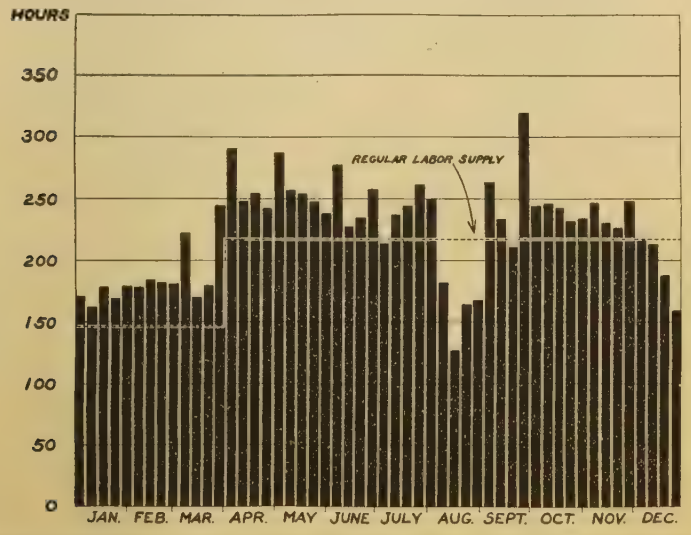

Fig. 21. Distribution of Labor by Weeks and Regular Supply of Labor (Present Organization)

The labor needed on this farm as now operated exceeds the regular supply by a wide margin. Irregular day labor used to fill in is not as dependable and usually is more expensive than regular workers hired by the season or year.

TABLE XX

MATERIAL COSTS FOR CROPS

	Seed per acre	Twine per acre	Threshing per bu.
	lbs.	lbs.	cents
Corn for grain	8	..	..
for fodder or silage	16	4	..
Oats	80	3½	3.5
Oats and barley	80	3½	3.5
Rye	84	2½	6.0
Winter wheat	90	3	6.0
Clover	8	..	..
Timothy	4	..	..
Alfalfa	12	..	..

The actual feeds and labor used for livestock production are shown in Table XXI.

TABLE XXI
AMOUNTS OF FEED AND LABOR USED FOR LIVESTOCK

	Corn	Small grain	Hay	Silage	Corn fodder	Skim-milk and butter-milk	Vet. services and medicine	Man labor	Horse work
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		hrs.	hrs.
Per work horse	1750	1325	3250	....	....	....	$0.80	75.0	..
Per colt	400	350	520	....	....	....	...	*	..
Per cow	400	1575	2900	7500	375	....	0.30	150.0	5.0
Per head young cattle	50	175	1900	3000	250	1900	...	42.0	..
Per 100 lbs. pork	260	160	....	...	....	500	...	4.2	0.5
Per 100 chickens	250	2100	....	....	....	....	...	144.0	..

* Included with work horses.

The crops raised on this farm are all fed to livestock. The disposal of the several crops is shown in Table XXII.

TABLE XXII
DISPOSITION OF CROPS PRODUCED

	Total production	Seed	Net production	Amount fed
	lbs.	lbs.	lbs.	lbs.
Corn for grain	83,160	680	82,480	79,800
for silage	292,000	....	292,000	291,000
for fodder	18,000	....	18,000	17,750
Oats	22,400	1240	21,160	21,000
Oats and barley	72,000	3600	68,400	67,000
Rye	5,880	588	5,292	5,200
Hay	180,000	....	180,000	178,320

Not all of some crops is needed for feed. In actual practice the balances would be large in years of high yields and disappear in years of low yields. Usually it is well to have some surplus in a normal year in order not to be too short when yields are low. This surplus may be sold or some temporary expansion of the livestock enterprises may be made to take care of it.

An earning statement of the farm under the present organization is presented in Table XXIII.

TABLE XXIII

FINANCIAL RETURNS FROM PRESENT ORGANIZATION

Sales			
Butterfat, 4200 lbs. at 50 cents	$2100		
Cows	300		
Veal calves and heifers	500		
Pork, 17,000 lbs. at 8 cents	1360		
Poultry and eggs	100		
Total sales			$4360
Cash Crop Costs:			
Seed (timothy and clover)	55		
Twine (small grain)	28		
Twine (corn)	13		
Threshing	94		
Direct cash crop costs		$190	
Cash Livestock Costs:			
Horses (shoeing and medicine)	9		
Cows (veterinary costs)	8		
Salt	9		
Swine (2400 gal. buttermilk)	50		
Direct cash livestock costs		76	
Hired Labor		1375	
Total cash cost of extra labor and materials			1641
Returns to organization after deducting cost of extra labor and materials			$2719

Weaknesses of Present Organization

As this farm is now organized, the labor demand of the enterprises is too heavy during most of the year to be supplied by three men and yet is hardly sufficient to provide regular employment for four. An increase in intensity of production is therefore suggested that will result in a better adjustment of labor supply to demand. Such a change should make a fuller utilization of the available horse labor. Another weak spot in the present organization is the low production of the dairy herd. The cows are well bred and are fed liberally. The ration, however, is low in protein. The tame hay fed contains a large percentage of timothy and the grain ration includes no high protein concentrates. Some high protein feed should be introduced into the ration. All the rye produced is being fed to the hogs. It is not a very satisfactory feed for swine, especially when fed in large quantities. For the community studied, it is not highly profitable as a cash sale crop—can

not compete with winter wheat. Therefore it is recommended that a more suitable crop be selected for the acreage now in rye. Other defects in the present organization could be cited. As the purpose of the proposed changes is to illustrate methods of using the data presented in Part II rather than to correct all the defects, no other faults need to be pointed out.

Reorganization Plan No. 1. Readjusting to Improve the Quality of Feed and to Provide a Cash Sale Crop

To correct the protein deficiency of the dairy ration, it is suggested that tame hay be replaced with alfalfa. As alfalfa yields about twice as much as timothy and clover, only half as large an acreage will be needed to provide the same quantity of hay. The rest of the tame hay land will be seeded to winter wheat. The rye will also be replaced with winter wheat. The winter wheat will add to the cash income. Table XXIV shows the cropping system with the proposed changes.

TABLE XXIV
PROPOSED CROPPING SYSTEM (REORGANIZATION PLAN NO. 1)

	Acres	Yield per acre	Total yield	Amount for seed	Amount for feed	Amount for sale
Corn for grain, bu.	33.0	45	1485	12	1425	...
for silage, tons	22.5	6½	146	..	146	...
for fodder, tons	3.5	2¾	9	..	9	...
Oats, bu.	15.5	45	700	39	656	...
Oats and barley, bu.	45.0	40	1800	90	1675	...
Wheat, bu.	30.0	20	600	45	....	555
Alfalfa, tons	23.0	3½	81	..	80	...
Wild hay, tons	7.0	1¼	9	..	9	...
Total crop area, acres	179.5					
Pasture (permanent), acres	92.5					
Farmstead and waste, acres	8.0					
Total farm area, acres	280.0					

No change in the number of livestock is considered, except that pork production will be curtailed slightly, as the feed for hogs is reduced by the amount of rye eliminated. It is, however, assumed that the substitution of alfalfa for timothy and clover hay will provide a greater supply of protein for the dairy ration and hence increase dairy production 10 per cent. Where a similar substitution has been made on other farms included in this study, much larger percentage increases have resulted, hence the estimate is conservative. This reorganization has another advantage—the introduction of wheat as a cash crop adds an element of diversity to the income of the farm organization and should tend to stabilize the earnings. The increase in earnings under the new plan is given in Table XXV.

TABLE XXV

FINANCIAL STATEMENT OF REORGANIZATION PLAN NO. 1

Crop Sales:			
550 bu. wheat @ $1.20		$660	
Livestock and Livestock Products Sales:			
Butterfat, 4620 lbs. @ 50c per lb.	$2310		
Cows	300		
Veal calves and heifers	500		
Pork, 15,750 lbs. @ 8c	1260		
Poultry and eggs	100		
Total livestock sales		4470	
Total crop and livestock sales			$5130
Cash Crop Costs:			
Seed, alfalfa	32		
Twine, small grain	36		
Twine, corn	13		
Threshing	124		
Direct cash crop costs		205	
Cash Livestock Costs:			
Same as present organization		76	
Hired labor		1525	
Total costs of extra labor and materials			1806
Returns to organization after deducting cost of extra labor and materials			$3324
Net increase over present plan of operation			$ 605

The new plan of operation does not involve any change in buildings, equipment, or livestock investment. The only additional cash outlay necessary has been provided for in the estimates of expense. The net income of the farm is increased $605. This new plan adds 530 hours of man labor and 1120 hours of horse work. The 12 horses now maintained can easily carry the additional load, but the extra man labor must be hired. A comparison between the labor distribution of the present plan and that of the proposed plan is shown in Figure 22. The new plan offers little advantage. Only during the last two weeks in June and the first week in July the labor was lower than at present. At other times it is the same or greater. The second cutting of alfalfa and the stacking of small grain combine to make a heavy peak load about the first of August. The third cutting combines with wheat seeding to make another peak the first week in September. Both these peak loads might be better distributed by exchanging labor with neighbors. The peak during stacking might be avoided by a combination of shock threshing and exchange work. This increased labor load has been allowed for in cash expense.

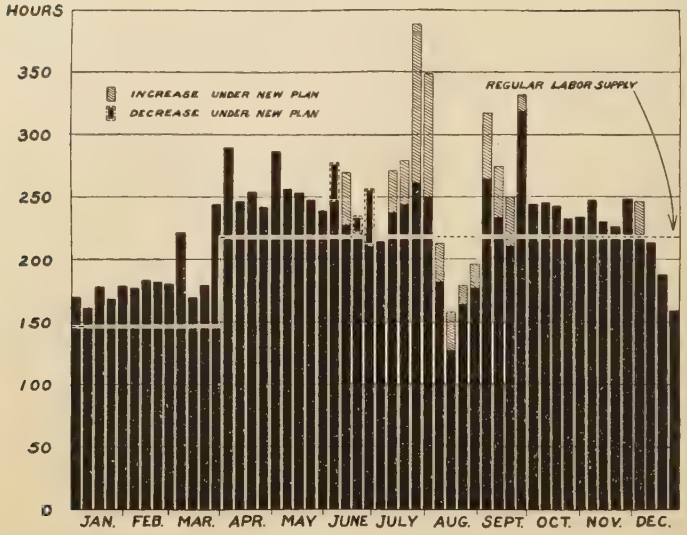

Fig. 22. Comparison of Distribution of Labor by Weeks of Present Plan and First Proposed Plan with Regular Labor Supply

The proposed plan presents a labor distribution no better than the present. Alfalfa seeding conflicts with harvest in July and with wheat seeding in September. More irregular day labor must be hired than before.

Reorganization Plan No. 2. Readjusting to Utilize Labor and Maintain Fertility

The first plan suggested provides a substantial increase in the net income of the farmer. It does not, however, remedy the irregular distribution of labor. There may also be some question as to maintaining the fertility of the soil with the small acreage of legumes and the selling of a considerable quantity of wheat each year. A second alternative is therefore proposed, which will to a large extent avoid these defects. The cropping system in plan No. 2 is the same as in plan No. 1 except that winter wheat is replaced with corn. This is fed to hogs, increasing the pork production from 17,000 to 32,000 pounds. This larger pork production provides a more advantageous utilization of skimmilk. Instead of 500 pounds per 100 pounds of pork produced, about 285 pounds will be available. The grain requirement for producing 100 pounds of pork is increased about 20 pounds to offset the decreased amount of skimmilk. Altho pork production is increased nearly 90 per cent, the increase in labor is estimated at 60 per cent. This estimate is very conservative as compared with actual records on

farms where the swine enterprise was materially increased. It is assumed that the other livestock remain the same and receive the same feed as in Plan No. 1.

TABLE XXVI

REORANIZED CROPPING SYSTEM (REORGANIZATION PLAN NO. 2)

	Acres	Yield per acre	Total yield	Amount for seed	Amount for feed	Amount for sale
Corn for grain, bu.	63.0	45	2835	12	2823	...
for silage, tons	22.5	6½	146	..	146	...
for fodder, tons	3.5	2½	9	..	9	...
Oats, bu.	15.5	45	700	39	656	...
Oats and barley, bu.	45.0	40	1800	90	1675	...
Alfalfa, tons	23.0	3½	81	..	80	...
Wild hay, tons	7.0	1¼	9	..	9	...
Total crop	179.5					
Pasture (permanent)	92.5					
Farmstead and waste	8.0					
Total farm area	280.0					

TABLE XXVII

FINANCIAL STATEMENT OF REORGANIZATION PLAN NO. 2

Sales:			
Butterfat, 4620 lbs. at 50 cents per lb.	$2310		
Cows	300		
Veal calves and heifers	500		
Pork, 32,000 lbs. at 8 cents per lb.	$2560		
Poultry and eggs	100		
Total sales			$5770
Crop Cost:			
Seed, alfalfa	$ 32		
Twine (corn)	13		
Twine (small grain)	25		
Threshing	88		
Direct cash crop costs		$158	
Cash Livestock Costs:			
Same as present organization		76	
Hired labor		1680	
Total cost of extra labor and materials			1914
Returns to organization after deducting cost of extra labor and materials			$3856
Net increase over present plan of operation			$1137

The distribution of labor under this plan is indicated in Figure 23. Enough labor is added that two hired men would be needed throughout the year and an extra man from April 1 to December 1. By employing these men for the year or the season, the labor cost would be less than

if day labor must be hired during rush seasons. There are only a few weeks during the year when this supply would not be adequate. These could easily be handled by exchange work or by the present labor force working more hours per day. Only the labor actually used on this farm is shown. Exchange labor received is included, that rendered is not. The decrease in labor in August does not represent a lull in farm work. During this period one or two men are doing exchange work. Through this exchanging of services the labor performed by the farm workers is kept at a fairly constant level. There is some margin between labor supply and demand throughout the year. This margin of safety provides a desirable element of elasticity in the business. It is, however, entirely possible that the labor demands of the farm could be adequately met and the labor cost reduced by employing a boy in place of one hired man. By assigning to him the lighter tasks, it would still be possible to operate this plan.

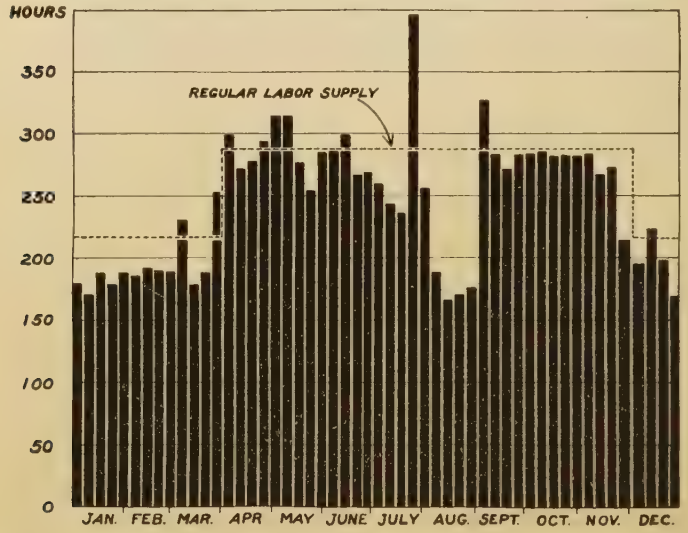

Fig. 23. Distribution of Labor by Weeks and Regular Supply (Reorganization Plan No. 2)

By increasing the corn acreage and the pork production, the productive labor is increased to the point where the hiring of an extra man is justified. Under this plan the labor can all be provided by men hired by the season or year and no day laborers are needed.

The plan provides a very substantial increase in the net income of the farm. It calls for no buildings or equipment not now on the farm. The swine breeding herd would be approximately doubled, but pigs are raised on the farm, so no direct cash outlay is involved. Some labor could be saved by substituting a two-row cultivator for two of

the three one-row cultivators now on the farm. Some labor is also saved by the plan of hogging-off 7 acres of corn instead of only 2½, as is now practiced. Two litters of pigs will be raised as at present. The cattle sold under both plans are veal calves, surplus heifers, and cows culled out of the herd. It is assumed that these remain the same, although the substitution of alfalfa for clover and timothy will probably result in better growth of heifers, which may increase their sale value. Soil fertility should be maintained under this system, as butterfat and pork are practically the only products sold off the farm. Provision has been made for labor for hauling out the additional manure produced by the enlarged swine enterprise. This system of operation provides for a fuller utilization of the work horses, equipment, and buildings, all of which are adequate. This plan would call for 1210 more hours of man labor than are now being used, but provision has been made for this in the allowance for wages.

Other changes might be suggested that would further increase the net income. Labor rates for crops are rather high. By using larger equipment and power units these could be reduced. Possibly the tractor could be used to advantage for field operations instead of for belt work only, thus enabling the farmer to sell several work horses. In fact, 12 horses are more than should be required on 179½ acres of crop land even without a tractor. A more careful planning of the labor should increase returns by reducing the number of horses maintained. The dairy production is low in proportion to the amount of feed used. The use of alfalfa hay will help some, but there is need for better stock that will result from more careful breeding and culling. It is not the purpose of this study to suggest remedies for all the defects in the organization of the farms used as examples. The purpose is rather to illustrate the method used in applying the data presented and the principles mentioned in forecasting the results of specific changes.

Effect of Variations in Yield of Crops on Relative Returns from Different Plans

Changes in yields of crops from year to year would not materially affect the relative returns from the two plans suggested as compared with the present plan, as it would affect all in the same way. Should the yield of wheat drop to 10 bushels per acre, other crops remaining the same, the advantage of the first reorganization plan would fall from $605 to only a little more than $270. On the other hand, with a 35-bushel yield, as in 1924, the increase in income would be approximately $1100 instead of $600. A dry season would affect the hay yields less than at present, as alfalfa is more drouth resistant than timothy and clover.

Effect of Price Change on Relative Returns from Different Plans

A decrease in the price of wheat from $1.20 to 90 cents per bushel would decrease the advantage of Plan No. 1 over the present plan from $605 to $440, providing there were no changes in the other cost factors. An increase in price to $1.60 per bushel, on the other hand, increases the added return to $825. In Plan No. 2 the added return would be decreased $240 by a decline in pork prices to 6½ cents per pound, and increased $320 by a rise to 10 cents. In either plan there seems to be an advantage in net return over the present organization, even with a material decline in prices. A radical change in price of products would probably be accomplished by changes in price of the cost factors, so that an exact forecast of the resulting effect on income is not possible.

Illustration No. 2. Resources and Present Organization

The following is the description of the resources and productive organization of a farm as it existed in 1921. Normal crop yields have been substituted for actual, as in the previous illustration. These comparisons are made on the basis of normal practices, normal yields, and normal price relations so far as these can be determined.

TABLE XXVIII

DISTRIBUTION OF ACREAGE AND PRODUCTION OF CROPS (PRESENT ORGANIZATION)

	Acres	Yield per acre	Total production
Corn for grain, bu.	48	40	1920
for silage, bu.	21½	6½	140
Oats, bu.	28	45	1260
Barley, bu.	3	25	75
Oats and barley, bu.	17	45	765
Succotash (wheat and oats), bu.	4½	20	90
Tame hay, tons	10½	1½	16
Wild hay, tons	13¼	1¼	17
Total crop acres	146		
Pasture (permanent), acres	55		
Farmstead and waste, acres	6		
Total farm area, acres	207		

The buildings on this farm will shelter 25 cows, 20 head of young dairy cattle, 20 brood sows and their pigs, and 200 chickens. The livestock maintained and the production from this stock are shown in Table XXIX.

TABLE XXIX

NUMBER OF HEAD AND PRODUCTION OF PRODUCTIVE LIVESTOCK (PRESENT ORGANIZATION)

Kind of livestock	No. of head	Production
Cows	21	4,200 lbs. butterfat
Bull	1	.....
Other cattle	16	.....
Brood sows	12	22,000 lbs. pork
Chickens	200	.....

A statement of the man labor supply and of the power and equipment utilized under the existing plan of operation are as follows.

TABLE XXX

LABOR, POWER, AND EQUIPMENT SUPPLY (PRESENT ORGANIZATION)

A. Man Labor:
   Two operators (partners) for entire year
   Operator's wife, who assisted with dairy utensils and care of poultry
   Extra help as needed
B. Power:
   Eight horses throughout the year[6]
C. Machinery:
   Fully equipped for all crops grown or suggested

The distribution of the labor actually performed on this farm is shown in Figure 24. The regular supply of labor is computed on the basis of an average or a normal length of working day for the regular workers. The same hours per day are used throughout the year. In actual practice the hours of work per day are increased or decreased according to the press of work. Extra labor hired at irregular intevals is

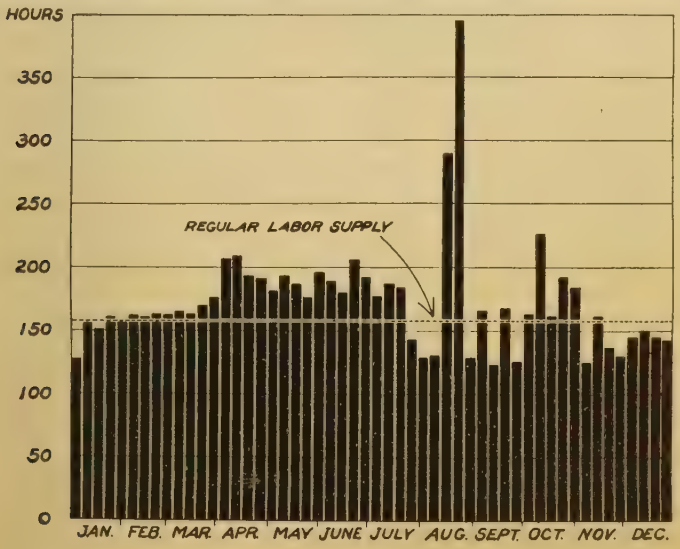

Fig. 24. Distribution of Labor by Weeks and Regular Supply of Labor (Present Organization)

The present labor load is a little too heavy for the regular supply of labor to handle. Even tho working more hours per day during the busy season, the regular labor supply must be supplemented at times by extra hired labor. Exchanging labor with neighbors serves to smooth the labor distribution.

[6] Two colts are kept in addition to the 8 work horses.

not included in the regular labor supply. Through most of the crop season the enterprises of this farm required more labor than that furnished by the regular supply—340 hours of extra labor being hired. The res. was made up by the regular men working more hours per day in rush seasons. Some of the irregularities were smoothed out by exchanging work with neighbors. Most of the exchange work was received during threshing and silo filling the latter part of August. During the slack periods just before and after this peak load period, the regular workers spent considerable time on other farms. As the supply of horse work available exceeded the amount needed at all times except during threshing and silo filling, when it was supplemented by exchange, no distribution of horse work is presented. The following prices are used in the computations of cost and income: corn, 65 cents per bushel; oats, 40 cents per bushel; tame hay, $12 per ton; oilmeal, $50 per ton; butterfat, 50 cents per pound; pork, 8 cents per pound.

Labor rates for the crops affected are shown in Table XXXI. Material expenditures for crops are shown in Table XXXII and the amount of feed and labor used for livestock in Table XXXIII.

TABLE XXXI

HOURS OF LABOR PER ACRE FOR CROP PRODUCTION

	Man	Horse		Man	Horse
Small grain			Alfalfa		
Plowing	2.5	10.0	1st cutting	7.5	10
Seedbed preparation	1.3	5.2	2d cutting	7.0	9
Seeding	0.8	3.2	3d cutting	5.0	7
Cutting	1.0	4.0	Tame hay, one cutting	7.5	10
Shocking	1.3	..	Wild hay, one cutting	6.5	9
Threshing	3.0	5.0			

TABLE XXXII

MATERIAL EXPENDITURES FOR CROPS

Crop	Seed per acre	Twine per acre	Threshing per bushel
	lbs.	lbs.	cents
Corn for grain	8	..	..
for silage	16	4.5	..
Oats	80	3.5	3.5
Barley	96	2.5	3.5
Oats and barley	80	4.0	3.5
Succotash	92	2.5	4.5
Timothy	4	..	..
Clover	8	..	..
Alfalfa	12	..	..

TABLE XXXIII

AMOUNT OF FEED AND LABOR USED FOR LIVESTOCK PRODUCTION

	Corn	Small grain	Oilmeal	Tame hay	Wild hay	Silage	Skim-milk	Vet serv. and med.	Hours of labor	
									Man	Horse
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.			
Per work horse	1400	1000	..	400	3200	....	....	$1.25	85	8.0
Per colt	375	700	..	1200	....	....	....	....	*	*
Per cow	110	450	68	1300	200	9500	....	0.65	150	5.0
Per head young cattle	...	300	10	1500	200	4500	2000	0.20	40	1.0
Per 100 lbs. pork	300	50	..	....	....	....	300	0.05	3	0.3
Per 100 chickens	...	3000	..	....	....	....	....	1.25	130	4.0

* Included with work horses.

All the roughage raised on this farm is fed to livestock, but a considerable amount of corn and oats is sold. The disposition of the crops is indicated in Table XXXIV.

TABLE XXXIV

DISPOSITION OF CROPS PRODUCED (PRESENT ORGANIZATION)

	Total production	Seed	Net production	Amount fed	Amount bought or sold
	lbs.	lbs.	lbs.	lbs.	lbs.
Corn for grain.....	107,520	728	106,792	80,260	26,532 (sold)
for silage	280,000	...	280,000	276,000	.....
Oats	40,320	2240	38,000	4,672	33,408 (sold)
Barley	3,600	288	3,312	3,312	.....
Oats and barley....	30,600	1360	29,240	29,240	.....
Succotash	4,140	414	3,726	3,726	.....
Tame hay	32,000	...	32,000	58,000	26,000 (bought)
Wild hay	34,000	...	34,000	33,200	.....

Weaknesses of the Present Organization

As this farm is now organized, the labor demand is too heavy during the crop season to be met by the regular supply of labor. During the year of this study the two operators worked over twelve hours per working day as an average throughout the year and six hours on Sunday. Even then some day help was hired during the crop season. On the other hand, there is hardly enough labor to justify the hiring of another regular man.

The dairy herd is of good dairy breeding, carefully bred and selected for high production. At present they are not fed heavily enough for as high production as their quality and breeding seem to make possible. They are using efficiently the feed they receive, but increased feeding should increase production without a corresponding increase in cost.

Under the present arrangement the fertility of the soil is likely to be depleted. When crops are sold, a great deal more fertility is re-

moved than if the same feed were fed to livestock and only livestock products sold. In reorganizing the farm business some provision should be made to maintain or increase the fertility.

The earning capacity of the farm under the prevailing plan of operation is indicated in Table XXXV.

TABLE XXXV

FINANCIAL RETURNS FROM PRESENT ORGANIZATION

Crop Sales:			
470 bu. corn @ 65c	$ 306		
1040 bu. oats @ 40c	416		
Total crop sales		$ 722	
Livestock Sales:			
4200 lbs. butterfat @ 50c	2100		
4 cows @ $70	280		
2 heifers @ $50	100		
14 veal calves at $9	126		
22,000 lbs. pork @ 8c	1760		
Poultry and eggs	220		
Total livestock sales		4586	
Total crop and livestock sales			$5308
Cash Crop Costs:			
Seed (timothy and clover)	13		
Twine (small grain)	22		
Twine (silage corn)	12		
Threshing	78		
Direct cash crop costs		125	
Cash Livestock Costs:			
Veterinary services and medicine			
Horses (including shoeing)	10		
Cows	14		
Young cattle	4		
Swine	11		
Poultry	3		
Total veterinary services and medicine		42	
Feed and Materials Purchased:			
Tame hay, 13 tons @ $12	156		
Oilmeal, 1700 lbs. @ $2.50	43		
Salt	9		
Grinding feed	35		
Total feed and materials		243	
Direct cash livestock costs		285	
Hired labor		85	
Total cost of extra labor and materials			495
Total returns to organization after deducting extra labor and material costs			$4813

Reorganization Plan—Substituting Equipment for Hand Labor and Increasing the Dairy Herd

A saving of at least 20 man hours per cow could be guaranteed by the installation of a milking machine. This is a conservative estimate in view of the savings actually accomplished on other farms studied where milking machines were installed. It is, therefore, proposed that a machine be obtained to reduce the labor on cows. This substitution of mechanical equipment for hand labor is intended to shorten the length of the working day rather than reduce the amount of hired help.

An increase in the amount fed to the cows should mean a large increase in their production. It is necessary to continue to breed and cull very carefully in order to take full advantage of the heavier feeding. In increasing the feed it is necessary to increase the quality as well as the quantity of the ration. The suggested ration for one cow for a year is as follows:

Corn (as at present), lbs....	110	Alfalfa hay, lbs.	2400
Oats and barley, lbs.....	1700	Silage (as at present), lbs...	9500
Oilmeal, lbs.	125		

The nutritive ratio of the suggested ration is much narrower than of that now fed. Altho the total digestible nutrients have been increased less than 50 per cent, the digestible protein has been more than doubled. The nutritive ration of the suggested ration is 1 : 6.5 as compared with 1 : 10.0 for the present ration. It is estimated that this increase in quantity and quality of the ration will raise the production of butterfat from 200 to 300 pounds per cow annually. This increased dairy production will also furnish additional skimmilk as a protein supplement for hogs.

The cropping system should provide adequately for the maintenance of soil fertility. It is suggested that all crops grown be fed and that the crops be adjusted to provide the maximum quantity of feed of the kinds best suited to the livestock. The corn acreage for both grain and silage is left as at present. Oats, barley, and succotash crops will be dropped and the area of the oats and barley mixture increased to 48 acres. Clover and timothy hay will be dropped and 3 acres of the wild meadow will be plowed up. The rest of the wild meadow is too poorly drained for regular cropping. Hay would be provided by seeding 14 acres of alfalfa in addition to the wild hay. Four acres would also be seeded to alfalfa for hog pasture. The present pasture for cattle would be supplemented by seeding 10 acres of the small grain land to sweet clover each year and using it in the late summer and fall.

TABLE XXXVI

Reorganized Cropping System

	Acres	Yield per acre	Total yield	Amount for seed	Amount for feed	Amount sold
Corn for grain, bu.	48	40	1920	13	1907	None
for silage, tons	21.5	6½	140	..	140	None
Oats and barley, bu.	48	45	2160	96	2064	None
Alfalfa, tons*	18	3	42	..	42	None
Wild hay, tons	10.5	1¼	13	..	13	None
Total crop acres	146					
Pasture (permanent), acres	55					
Farmstead and waste, acres	6					
Total farm area, acres	207					

* Only 14 acres cut for hay.

The stock would remain as at present except that the swine enterprise would be expanded to use the grain which is now sold. All stock would be fed as at present except the dairy cows. The hogs would have additional skimmilk and four acres of alfalfa pasture. Sufficient grain would be available for the production of an additional 12,000 pounds of pork. Even with this increase, there would be as much grain per 100 pounds of pork produced as at present and an increase of 70 pounds of skimmilk per 100 pounds.

The distribution of labor under the new plan of operation is indicated in Figure 25. Except during the periods of cutting and putting up alfalfa hay and threshing small grain, there is a slight reduction in the hours per week throughout the year. The increase in labor caused by alfalfa is more than offset by the decrease the rest of the year, the net decrease amounting to 155 hours. The expense for extra hired labor under this plan should be no greater than at present. The present horse labor supply is entirely adequate for the new plan.

This suggested plan of operation provides a net increase of $1280 in the farm income and yet requires no additional buildings and no extra equipment other than the milking machine, for which provision has been made in the statement of expense. The productivity of the soil should be better maintained under this system, as all the crops raised are fed on the farm and more manure is available. The additional sweet clover pasture should provide more adequately for the dairy herd. More skimmilk as well as alfalfa pasture would be available for the hogs.

TABLE XXXVII

FINANCIAL STATEMENT UNDER REORGANIZED PLAN

Crop Sales:			
None			
Livestock Sales:			
Butterfat, 6300 lbs. @ 50c per lb.	$3150		
4 cows @ $70 per head	280		
2 heifers at $50 per head	100		
14 veal calves @ $9 per head	126		
34,000 lbs. pork @ 8c per lb.	2720		
Poultry and eggs	220		
Total sales			$6596
Cash Crop Costs:			
Seed, alfalfa	25		
Seed, sweet clover	12		
Twine, small grain	23		
Twine, silage corn	12		
Threshing	76		
Direct cash crop costs		$148	
Cash Livestock Costs:			
Veterinary services and medicine			
Horses (including shoeing)	10		
Cows	14		
Young cattle	4		
Swine	17		
Poultry	3		
Total veterinary service and medicine		48	
Feed and Materials Purchased:			
Oilmeal, 2800 lbs. @ $2.50	70		
Salt	12		
Grinding feed	70		
Total feed and materials		152	
Direct cash livestock costs		200	
Hired labor (as at present)		85	
Milking machine (25 per cent of first cost)		70	
Total cost of extra labor and materials			503
Total return to organization after deducting extra labor and material costs			$6093
Net increase over present plan of organization			$1280

This system of reorganization allows considerable elasticity, as the swine enterprise can be readily expanded or contracted with an increase or decrease in crop yields. Some elasticity is also possible in the dairy enterprise. As there is a marked tendency for corn and small grain to vary inversely in yields, the balance of these crops tends to stabilize the feed supply. Alfalfa is affected less by drouth than clover and timothy, hence insures a more uniform supply of hay. As one of the principal changes involved in this plan is to utilize more fully the productive capacity of the dairy herd, the advantage over the present plan would hold even with a considerable shift in prices. The other important change is the expansion of the swine enterprise to utilize the concentrates grown on the farm. The skimmilk available for swine feeding gives this farm an advantage in pork production that would still hold in the face of a considerable reduction in pork prices and a marked increase in grain prices.

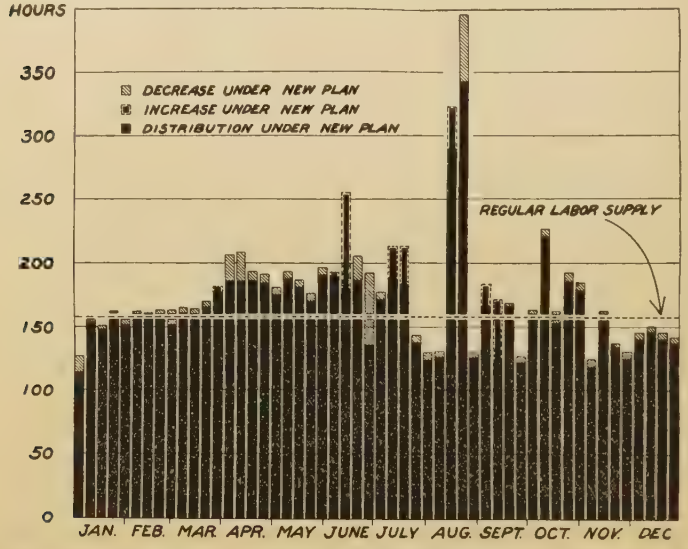

Fig. 25. Distribution of Labor by Weeks Under Proposed Plan, Regular Labor Supply, and Differences Between Present and Proposed Plan

The proposed plan lightens the labor load except during three short periods when work on alfalfa is under way and during threshing. The increases during these periods are more than offset by the labor saving during the rest of the year.

These examples of adjustment in the farm organization are intended only to illustrate a method of using such data as have been presented in forecasting the effect on the farm income of changes in or combinations of enterprises. It is not assumed that all possibilities for improv-

ing the organization were considered. Only specific changes were suggested and the resulting effect on the net income of the farm was determined. This method can, however, be applied quite generally in a study of many possible alternatives.

Altho this method is adapted primarily to the study of a particular farm, it is easily possible by applying it to specific farms representative in type and organization of a considerable group, to draw conclusions of significance for the whole group. The careful and consistent application of this method to the study of the various possible alternatives in the selection, combination, and adjustment of farm enterprises, both by individual farmers and by research and extension workers, should tend to speed up desirable readjustments and stabilize the returns from agricultural production.

SUMMARY

Part I

The study is based on detailed farm records kept on a group of farms in Steele County, Minn., from 1920 to 1924, inclusive.

Steele County is typical of most of the dairy section of southeastern Minnesota in soil, climate, markets, and conditions affecting the dairy industry as well as in agricultural development.

The first settlers came into the county in 1853.

A system of grain farming was first developed, with wheat as the main source of income.

Decreased yields due to continuous cropping with wheat and also to diseases and insect pests led to a shift from grain farming to livestock production.

Since 1880 the amount of livestock has increased steadily from 7 to more than 20 animal units of productive livestock per farm.

During the same period the percentage of the crop acreage in wheat has declined from more than 50 per cent to less than 10 per cent.

In 1924 corn occupied 29 per cent of the crop acreage, hay 28 per cent, oats 23 per cent, and other small grains 16 per cent.

Dairy cattle, swine, and poultry have increased steadily since 1880, but beef cattle and sheep have declined.

For each 100 acres of land there are at present 10.3 milk cows, 44 young dairy cattle, 13.5 swine, 78.9 chickens, and 0.6 sheep.

The principal sale products of these farms are hogs, and cream for manufacture into butter.

The farms studied received 52 per cent of their income from the sale of dairy products and cattle, 29 per cent from swine, 6 per cent from other livestock, 11 per cent from crops, and 2 per cent from miscellaneous sources.

Part II

The amounts of feed and of labor and materials used for livestock and crop production are presented in Part II. The actual expenditures of each farm for one year, the average for each of the five years, and suggested standards are presented. Causes for variations are explained and discussed. The following is a summary of the livestock expenditures.

	5-yr. average	Range	Standard
Per dairy cow (per year):			
Concentrates, lbs	1691	81-2799	1900
Dry roughage, lbs.	2472	1141-4147	2500
Succulent roughage, lbs.	8273	5509-18,284	9000
Pasture, days	182	151-221	160
Man labor, hrs.	166	85-258	150
Horse work, hrs.	9	3-32	10
Butterfat production, lbs.	193	147-285	250
Per head young dairy stock (per year):			
Concentrates, lbs.	373	54-1104	500
Dry roughage, lbs.	1660	707-2185	2000
Succulent roughage, lbs.	3575	1445-7317	4000
Milk, lbs.	1895	806-4839	2025
Pasture, days	65	8-77	60
Man labor, hrs	38	9-83	40
Horse work, hrs.	2	1-13	5
Per 100 lbs. of pork produced:			
Grain, lbs.	428	296-634	375
Tankage, lbs.	3	0-17	....
Skimmilk, lbs.	364	22-1154	350
Pasture, days	30	0-70	30
Man labor, hrs.	5.5	2.9-10.7	4
Horse work, hrs.	0.6	0-5.2	0.5
Per 100 chickens (per year):			
Grain, lbs.	2910	1565-8393	3500
Meat scraps, lbs.	9	0-100	....
Skimmilk, lbs.	702	0-2367	2000
Man labor, hrs.	201	54-300	175
Horse work, hrs.	4	0-37	4
Eggs laid, number	5093	2519-10,120	6500
Poultry produced, lbs.	318	0-1081	300
Per work horse (per year):			
Grain, lbs.	3020	748-4229	3000
Hay, lbs.	4830	3152-8740	5000
Pasture, days	56	0-160	60
Man labor, hrs.	89	33-114	80
Work performed, hrs.	835	516-1170	1000
Per colt (per year):			
Grain, lbs.	707	140-2323	1000
Hay, lbs.	1709	694-4503	2000
Pasture, days	178	0-278	*
Man labor, hrs.	24	8-85	25

* All season.

A summary of the labor used per acre for crop production is presented below. The labor rates by operations are presented in Part II, together with a statement of seed, twine, and other materials used.

	5-yr. average	Range	Standard
Corn, all work up to harvest time:			
Man hrs.	12.5	10.3-21.1	11
Horse hrs.	31.0	17.7-57.7	33
Tractor hrs.	1.2	0- 3.4	..
Cutting:			
Man hrs.	1.7	1.0- 2.4	1.6
Horse hrs.	5.1	3.1- 7.1	4.8
Shocking:			
Man hrs.	3.7	2.2- 6.6	3.0
Filling silo:			
Man hrs.	11.4	7.2-21.6	11.0
Horse hrs.	14.7	10.2-27.0	13.5
Husking (standing corn).			
Man hrs.	8.8	4.1-11.7	7.5
Horse hrs.	14.6	7.0-26.5	15.0
Husking and shredding:			
Man hrs.	10.5	6-15.7	9.5
Horse hrs.	14.1	9.1-20.5	12.0
Small grain (shock threshed):			
Man hrs.	10.1	7.5-15.0	9.0
Horse hrs.	19.6	9.8-30.9	22.0
Tractor hrs.	1.0	0- 1.5	....
Tame hay (1 cutting):			
Man hrs.	6.0	3.8- 9.0	6.0
Horse hrs.	9.5	7.1-15.9	9.0
Alfalfa (3 cuttings):			
Man hrs.	20.3	11.8-29.0	15.0
Horse hrs.	28.4	14.6-34.6	22.0

The range in physical expenditures indicates the wide range in degree of efficiency of production between different farms. The standards of production serve as a measure by which the individual producer may check his own efficiency.

In addition to the direct work on livestock, an additional 3.5 per cent of man labor and 56.5 per cent of horse work are performed as indirect work, such as feed hauling, grinding, etc.

Each year 20 per cent of the crop acreage on the farms studied is manured at an average rate of ten loads per acre.

In addition to the field work on crops, an additional 3.5 per cent of man labor and 1 per cent of horse work is spent on such miscellaneous crop work as cleaning and treating seed, marketing, etc.

Eighty-nine per cent of the man labor and 95 per cent of the horse work on these farms is used in caring for the crop and livestock enterprises. The rest consisted of maintenance or miscellaneous work.

A better distribution of labor throughout the year is made possible by a systematic classification of tasks according to time fixity and weather interference, and fitting these tasks into the labor program on this basis.

Peak labor loads can be handled and the hiring of special day labor avoided by exchanging labor with neighbors.

Tractors were used on 56 per cent of the farms studied.

Sixty per cent of the tractors were 3-plow tractors, 30 per cent 2-plow, and 10 per cent 4-plow.

The average amount of work per tractor annually was 182 hours of drawbar work and 78 of belt work on the home farm and 25 hours of custom work on other farms.

Part III

The choice of adjustment of enterprises for a given farm is based on the following considerations:

1. The adaptation of the enterprise to the conditions of the area.
2. The varying demands of the several enterprises on the resources of the farmer.
3. The inter-relations between enterprises.
4. The possibilities for utilizing relatively fixed resources in the farmer's possession.
5. The facility with which enterprises lend themselves to shifts.
6. Changes in prices of products or in prices of cost factors.

The use of such data as are presented in Part II in forecasting the effect on the net returns of a farm of changes in the choice and adjustment of enterprises, is illustrated. In the first example, alfalfa is substituted for timothy and clover hay, rye is dropped, and the acreage released is planted to winter wheat. This reorganization increases the net income of the farm $605. Another plan suggested involves an increase in corn in place of winter wheat, and a sufficient increase in swine to consume the additional corn.

This plan results in a better distribution and utilization of labor and in an increase of $1137 in the net income.

On another farm it was suggested that the dairy herd be fed more nearly to capacity, and that instead of selling grain it be fed to hogs, thus increasing pork production. This reorganization also provides for the substitution of alfalfa hay for timothy and clover and some minor shifts in the cropping system. This plan would result in an increase of $1280 in the net income. It involves changes in the selection and adjustment of enterprises and in efficiency within the enterprise.

APPENDIX

TABLE XXXVIII

MAN LABOR USED PER ACRE, BY OPERATIONS, FOR CORN UP TO HARVEST TIME, 1922

Farm No.	Acres per farm	Plowing		Disking		Spring-tooth harrowing		Harrowing		Planting	Cultivating		Total hours
		Hours	Times over	Hours	Times over	Hours	Times over	Hours	Times over	Hours	Hours	Times over	
21	90	1.7	1.2	0.1	0.3	1.0	2.3	0.6	1.3	1.1	5.8	5.0	10.3
18	66	4.2	1.7	0.2	0.4	0.1	0.2	0.8	2.7	0.8	4.2	4.3	10.3
5	50	2.8	2.0	0.5	2.0	0.3	0.5	1.3	3.8	1.0	4.6	4.2	10.5
27	30	4.1	1.2	0.6	1.1	..	..	0.8	2.4	0.9	4.4	2.5	10.8
29	30	2.3	1.6	..	..	0.4	0.5	1.3	3.2	1.0	6.3	5.0	11.3
36	50	2.9	1.0	0.3	0.4	0.2	0.3	1.0	2.9	1.0	6.6	4.9	12.0
20	70	1.8	1.3	1.6	2.0	..	..	1.0	4.0	0.8	7.2	5.0	12.4
31	50	4.1	1.3	..	..	0.7	1.6	0.4	1.0	0.9	6.6	4.5	12.7
14	38	2.8	1.0	0.1	0.1	1.0	1.0	0.7	2.0	1.1	7.3	4.8	13.0
24	37	1.7	1.0	..	..	1.4	2.7	0.7	2.0	1.0	8.3	5.9	13.1
25	54	2.6	1.0	1.0	2.0	1.0	0.9	1.0	2.0	1.0	6.8	3.7	13.4
15	54	4.5	2.0	..	..	1.4	1.9	1.5	4.2	0.9	5.1	4.4	13.4
23	42	2.8	1.5	..	..	1.5	1.9	1.2	4.6	0.7	7.3	5.0	13.5
16	37	4.3	1.6	..	..	0.9	0.9	1.2	3.0	0.8	6.6	4.8	13.8
12	38	3.6	2.0	0.4	0.6	1.0	1.0	1.2	2.0	0.8	6.8	4.4	13.8
1	33	3.9	1.3	0.6	1.0	0.5	0.6	1.0	2.0	0.8	7.3	5.4	14.1
26	59	2.9	1.7	0.4	0.6	1.7	1.4	1.5	3.1	0.7	7.6	4.4	14.8
35	30	4.0	1.7	..	..	1.4	1.9	2.4	6.0	0.8	6.5	4.9	15.1
10	40	6.1	1.5	..	..	2.0	3.1	0.9	2.2	0.8	6.6	4.7	16.4
28	33	3.4	1.8	..	..	2.5	3.3	1.4	3.5	0.7	11.1	5.0	19.1
9	47	8.2	2.0	..	..	0.9	1.4	1.2	3.6	1.1	9.7	5.7	21.1
Averages													
21 farms 1922	47	3.4	1.5	0.3	0.5	0.9	1.2	1.1	2.9	0.9	6.7	4.7	13.3
23 " 1920	39	2.4	1.1	0.2	0.4	*	*	1.4	3.4	0.7	7.1	5.4	11.8
21 " 1921	42	2.4	1.1	0.8	1.7	1.1	1.5	1.0	2.3	0.9	6.2	4.4	12.4
22 " 1923	43	2.9	1.2	1.0	1.8	0.7	1.3	0.9	2.6	0.8	5.7	4.1	12.0
23 " 1924	42	3.0	1.3	0.6	1.2	0.8	1.3	1.1	3.5	0.9	6.5	4.7	12.9

* Included with disking.

TABLE XXXIX

HORSE AND TRACTOR WORK USED PER ACRE, BY OPERATIONS, FOR CORN UP TO HARVEST TIME, 1922

Farm No.	Acres per farm	Plowing			Disking			Spring-tooth harrowing			Harrowing			Planting	Cultivating		Total	
		Horse hrs.	Tractor hrs.	Times over	Horse hrs.	Tractor hrs.	Times over	Horse hrs.	Tractor hrs.	Times over	Horse hrs.	Tractor hrs.	Times over	Horse hrs.	Horse hrs.	Times over	Horse hrs.	Tractor hrs.
21	90	0.5	1.5	1.2	..	0.1	0.3	..	1.0	2.3	1.9	0.1	1.3	2.1	13.2	5.0	17.7	2.7
18	66	14.9	..	1.7	0.9	..	0.4	0.4	..	0.2	3.4	..	2.7	1.5	11.2	4.3	32.3	..
5	50	2.3	2.2	2.0	..	0.5	2.0	0.8	0.1	0.5	4.7	..	3.8	2.0	11.3	4.2	21.1	2.8
27	30	12.5	..	1.2	2.5	..	1.1	..	..	..	3.0	..	2.4	1.8	8.8	2.5	28.6	..
29	30	...	2.3	1.6	..	..	..	0.1	0.4	0.5	4.4	0.2	3.2	2.0	12.5	5.0	19.0	2.9
36	50	14.6	..	1.0	0.9	..	0.4	0.6	..	0.3	2.9	..	2.9	2.0	13.5	4.9	34.5	..
20	70	11.7	..	1.3	6.6	..	2.0	..	..	..	4.0	..	4.0	1.6	17.7	5.0	41.6	..
31	50	8.8	1.6	1.3	..	..	..	..	0.7	1.6	1.7	..	1.0	1.7	13.2	4.5	25.4	2.3
14	38	11.1	..	1.0	0.3	..	0.1	4.0	..	1.0	3.0	..	2.0	2.1	14.7	4.8	35.2	..
24	37	1.4	1.3	1.0	..	..	..	1.0	1.2	2.7	2.3	0.2	2.0	2.0	16.6	5.9	23.3	2.7
25	54	10.6	..	1.0	4.2	..	2.0	4.0	..	0.9	2.8	..	2.0	2.0	13.5	3.7	37.1	..
15	54	6.4	2.2	2.0	..	..	..	0.8	1.2	1.9	6.0	..	4.2	1.8	11.8	4.4	26.8	3.4
23	42	7.2	0.9	1.5	..	..	..	..	1.5	1.9	4.5	..	4.6	1.3	14.1	5.0	27.1	2.4
16	37	15.1	..	1.6	..	..	..	3.6	..	0.9	4.8	..	3.0	1.5	13.2	4.8	38.2	..
12	38	5.2	2.0	2.0	0.9	0.1	0.6	4.9	..	1.0	3.8	..	2.0	1.6	15.2	4.4	31.6	2.1
1	33	14.7	..	1.3	2.4	..	1.0	1.6	..	0.6	2.0	..	2.0	1.6	15.5	5.4	37.8	..
26	59	15.9	..	1.7	1.3	..	0.6	7.5	..	1.4	5.3	..	3.1	1.4	15.2	4.4	46.6	..
35	30	13.8	0.5	1.7	..	..	..	4.6	0.2	1.9	8.5	..	6.0	1.6	13.5	4.9	42.0	0.7
10	40	18.5	..	1.5	..	..	..	8.5	..	3.1	3.2	..	2.2	1.5	13.2	4.7	44.9	..
28	33	3.0	2.5	1.8	..	..	..	8.6	0.3	3.3	4.8	0.2	3.5	1.2	20.4	5.0	38.0	3.0
9	47	27.8	..	2.0	..	..	..	3.6	..	1.4	4.7	..	3.6	2.1	19.5	5.7	57.7	..
Averages																		
21 farms, 1922	47	10.2	0.8	1.5	1.1	0.1	0.5	2.4	0.3	1.2	3.8	..	2.9	1.8	14.2	4.7	33.5	1.2
23 " 1920	39	4.5	1.0	1.1	0.2	0.1	0.4	..	..	..	3.5	0.4	3.4	1.4	15.2	5.4	24.8	1.5
21 " 1921	42	4.6	1.1	1.1	1.8	0.4	1.7	3.2	0.4	1.5	3.6	0.1	2.3	1.8	13.3	4.4	28.3	2.0
22 " 1923	43	10.4	0.2	1.2	3.6	0.1	1.8	2.8	0.1	1.3	3.4	..	2.6	1.6	12.0	4.1	33.8	0.4
23 " 1924	42	10.2	0.5	1.3	2.1	0.1	1.2	2.9	0.1	1.3	4.1	..	3.5	1.6	13.7	4.7	34.6	0.7

TABLE XL

MAN LABOR AND HORSE AND TRACTOR WORK USED PER ACRE FOR CORN HUSKED FROM STANDING STALKS, 1922

Farm No.	Acres per farm	Yield bu.	Before harvest			Husking			Total		
			Man hrs.	Horse hrs.	Tractor hrs.	Man hrs.	Horse hrs.	Tractor hrs.	Man hrs.	Horse hrs.	Tractor hrs.
5	25	40	10.5	21.1	2.8	4.6	8.9	..	15.1	30.0	2.8
20	48	31	12.4	41.6	..	4.1	7.0	..	16.5	48.6	..
21*	44	60	10.3	17.7	2.7	7.5	9.5	1.8	17.8	27.2	4.5
27	12	35	10.8	28.6	..	9.1	9.6	..	19.9	38.2	..
18	24	39	10.3	32.3	..	9.6	16.5	..	19.9	48.8	..
36	11	46	12.0	34.5	..	8.3	16.6	..	20.3	51.1	..
31	22	53	12.7	25.4	2.3	8.9	15.4	..	21.6	40.8	2.3
29	10	50	11.3	19.0	2.9	10.5	26.5	..	21.8	45.5	2.9
15	27	58	13.4	26.8	3.4	8.7	17.4	..	22.1	44.2	3.4
24	14	55	13.1	23.3	2.7	9.8	16.0	..	22.9	29.1	2.7
10*	29	38	16.4	44.9	..	6.5	14.4	..	22.9	59.3	..
26	25	59	14.8	46.6	..	8.4	16.8	..	23.2	63.4	..
16	23	52	13.8	38.2	..	10.0	17.7	..	23.8	55.9	..
12	22	36	13.8	31.6	2.1	10.1	15.9	..	23.9	47.5	2.1
23*	23	59	13.5	27.1	2.4	11.7	22.5	2.9	25.2	49.6	5.3
35	10	49	15.1	42.0	0.7	11.7	23.3	..	26.8	65.3	0.9
9*	25	40	21.1	57.7	..	9.4	20.1	..	30.5	77.8	..
Averages											
17 farms, 1922	23	48	13.3	33.5	1.2	8.0	14.5		21.3	48.0	1.2
12 " 1920	19	43	11.8	24.8	1.5	9.9	16.9	..	21.7	41.7	1.5
19 " 1921	20	49	12.4	28.3	2.0	9.5	13.9	..	21.9	42.2	2.0
14 " 1923	16	28	12.0	33.8	0.4	7.7	14.9	..	19.7	48.7	0.4
18 " 1924	20	32	12.9	34.6	0.7	8.8	12.7	..	21.7	47.3	0.7

* Mechanical picker used on these farms; data not included in computing the averages.

TABLE XLI

MAN LABOR USED PER ACRE, BY OPERATIONS, FOR SILAGE CORN, 1922

	Farm No.	Acres per farm	Yield tons	Before cutting hrs.	Cutting hrs.	Filling silo hrs.	Total hrs.
	20	13	6.9	12.4	1.5	7.2	21.1
	18	22	7.6	10.3	1.3	11.2	22.8
	21	29	7.0	10.3	2.3	10.6	23.2
	14	17	5.4	13.0	1.1	9.7	23.8
	27	13	6.1	10.8	1.3	12.1	24.2
	29	10	8.1	11.3	1.5	11.6	24.4
	24	16	6.9	13.1	2.0	9.9	25.0
	5	17	6.5	10.5	1.9	13.8	26.2
	31	15	7.6	12.7	1.6	12.1	26.4
	25	15	6.7	13.4	2.1	11.3	26.8
	26	26	5.8	14.8	1.7	10.3	26.8
	12	15	7.7	13.8	1.6	12.1	27.5
	35	18	6.6	15.1	1.0	11.5	27.6
	1	22	5.6	14.1	2.0	12.1	28.2
	36	6	5.4	12.0	2.4	16.5	30.9
	23	12	7.5	13.5	1.6	15.8	30.9
	15	18	7.9	13.4	1.7	16.3	31.4
	10	11	6.4	16.4	1.4	13.7	31.5
	16	9	9.0	13.8	1.7	21.6	37.1
	28	12	7.1	19.1	1.9	15.2	36.2
	9	12	6.7	21.1	1.9	21.2	44.2
Averages							
21	farms, 1922	16	6.8	13.3	1.7	12.5	27.5
23	" 1920	14	6.8	11.8	1.6	11.7	25.1
20	" 1921	14	6.8	12.4	1.9	12.1	26.4
22	" 1923	20	5.3	12.0	1.5	9.4	22.9
22	" 1924	16	6.4	12.9	1.7	11.1	25.7

TABLE XLII

HORSE AND TRACTOR WORK USED PER ACRE, BY OPERATIONS, FOR SILAGE CORN, 1922

	Farm No.	Acres per farm	Yield tons	Before cutting		Cutting	Filling silo	Total	
				Horse hrs.	Tractor hrs.	Horse hrs.	Horse hrs.	Horse hrs.	Tractor hrs.
	20	13	6.9	41.6	..	4.6	10.5	56.7	..
	18	22	7.6	32.3	..	3.9	11.6	47.8	..
	21	29	7.0	17.7	2.7	6.9	14.5	39.1	2.7
	14	17	5.4	35.2	..	3.3	10.3	48.8	..
	27	13	6.1	28.6	..	3.9	13.0	45.5	..
	29	10	8.1	19.0	2.9	4.4	16.7	40.1	2.9
	24	16	6.9	23.3	2.7	6.0	13.7	43.0	2.7
	5	17	6.5	21.1	2.8	4.7	15.9	41.7	2.8
	31	15	7.6	25.4	2.3	5.0	15.3	45.7	2.3
	25	15	6.7	37.1	..	6.3	14.3	57.7	..
	26	26	5.8	46.6	..	5.0	14.0	65.6	..
	12	15	7.7	31.6	2.1	4.8	16.9	53.3	2.1
	35	18	6.6	42.0	0.7	3.1	14.3	59.4	0.7
	1	22	5.6	37.8	..	6.0	13.4	57.2	..
	36	6	5.4	34.5	..	7.1	10.2	51.8	..
	23	12	7.5	27.1	2.4	4.9	22.2	54.2	2.4
	15	18	7.9	26.8	3.4	6.0	19.5	52.3	3.4
	10	11	6.4	44.9	..	4.3	16.4	65.6	..
	16	9	9.0	38.2	..	5.0	27.0	70.2	..
	28	12	7.1	38.0	3.0	5.5	20.5	64.0	3.0
	9	12	6.7	57.7	..	6.0	13.4	57.2	..
Averages									
21	farms, 1922	16	6.8	33.5	1.2	5.2	15.7	54.4	1.2
23	" 1920	14	6.8	24.8	1.5	4.8	14.1	43.7	1.5
20	" 1921	14	6.8	28.3	2.0	5.8	16.9	51.0	2.0
22	" 1923	20	5.3	33.8	0.4	4.6	12.4	50.8	0.4
22	" 1924	16	6.4	34.6	0.7	5.2	14.4	54.4	0.7

TABLE XLIII

MAN LABOR AND HORSE AND TRACTOR WORK USED PER ACRE FOR CORN HUSKED AND SHREDDED, 1922

Farm No.	Acres per farm	Yield bu.	Before harvest			Cutting		Shocking	Husking and shredding		Total		
			Man hrs.	Horse hrs.	Tractor hrs.	Man hrs.	Horse hrs.	Man hrs.	Man hrs.	Horse hrs.	Man hrs.	Horse hrs.	Tractor hrs.
29	9	50	11.3	19.0	2.9	1.5	4.4	5.0	6.0	10.0	23.8	33.4	2.9
31	9	40	12.7	25.4	2.3	1.6	5.0	4.2	6.7	10.7	25.3	41.1	2.3
18	10	40	10.3	32.3	..	1.3	3.9	5.2	11.4	14.6	28.2	50.8	..
14	13	55	13.0	35.2	..	1.1	3.3	3.0	11.4	15.5	28.5	54.0	..
1	12	60	14.1	37.8	..	2.0	6.0	3.1	9.5	19.0	28.7	62.8	..
26	6	59	14.8	46.6	..	1.7	5.0	5.0	11.3	10.3	32.8	61.9	..
28	14	45	19.1	38.0	3.0	1.9	5.5	4.0	7.8	9.1	32.8	52.6	3.0
21	8	60	10.3	17.7	2.7	2.3	6.9	4.9	15.7	20.5	33.2	45.1	2.7
24	5	50	13.1	23.3	2.7	2.0	6.0	6.7	13.3	17.8	35.1	47.1	2.7
Averages													
9 farms, 1922	9	51	13.3	33.5	1.2	1.7	5.2	4.7	10.0	14.0	29.7	52.7	1.2
7 " 1920	11	49	11.8	24.8	1.5	1.6	4.8	3.4	11.3	14.8	28.1	44.4	1.5
12 " 1921	9	45	12.4	28.3	2.0	1.9	5.8	4.7	13.6	18.8	32.6	52.9	2.0
11 " 1923	14	23	12.0	33.8	0.4	1.5	4.6	2.8	7.5	10.1	23.8	48.5	0.4
7 " 1924	8	30	12.9	34.6	0.7	1.7	5.2	2.7	10.0	12.7	27.3	52.5	0.7

TABLE XLIV

MAN LABOR AND HORSE AND TRACTOR WORK USED PER ACRE FOR CORN CUT AND SHOCKED, 1922

Farm No.	Acres per farm	Yield tons	Before harvest			Cutting		Shocking	Total		
			Man hrs.	Horse hrs.	Tractor hrs.	Man hrs.	Horse hrs.	Man hrs.	Man hrs.	Horse hrs.	Tractor hrs.
5	8	1.5	10.5	21.1	2.8	1.9	4.7	2.2	14.6	25.8	2.8
18	6	2.5	10.3	32.3	..	1.3	3.9	5.2	16.8	36.2	..
14	4	3.4	13.0	35.2	..	1.1	3.3	3.0	17.1	38.5	..
29	1	1.1	11.3	19.0	2.9	1.5	4.4	5.0	17.8	23.4	2.9
25	39	1.5	13.4	37.1	..	2.1	6.3	2.4	17.9	43.4	..
15	4	2.5	13.4	26.8	3.4	1.7	6.0	4.7	19.8	32.8	3.4
20	2	2.8	12.4	41.6	..	1.5	4.6	6.6	20.5	46.2	..
35	2	1.8	15.1	42.0	0.7	1.0	3.1	4.7	20.8	45.1	0.7
26	4	2.5	14.8	46.6	..	1.7	5.0	5.0	21.5	51.6	..
23	3	3.7	13.5	27.1	2.4	1.6	4.9	6.5	21.6	32.0	2.4
24	3	1.8	13.1	23.3	2.7	2.0	6.0	6.7	21.8	29.3	2.7
28	6	2.5	19.1	38.0	3.0	1.9	5.5	4.0	25.0	43.5	3.0
9	4	3.5	21.1	57.7	..	1.9	6.4	4.5	27.5	64.1	..
Averages											
13 farms, 1922	7	2.1	13.3	33.5	1.2	1.7	5.2	4.7	19.7	38.7	1.2
6 " 1921	5	1.7	12.4	28.3	2.0	1.9	5.8	4.7	19.0	34.1	2.0
14 " 1923	7	1.8	12.0	33.8	0.4	1.5	4.6	2.8	16.3	38.4	0.4
16 " 1924	8	2.0	12.9	34.6	0.7	1.7	5.2	2.7	17.3	39.8	0.7

TABLE XLV

MAN LABOR USED PER ACRE, BY OPERATIONS, FOR SMALL GRAINS, 1923

Farm No.	Acres per farm	Yield lbs.	Plowing		Disking		Spring-tooth harrowing		Harrowing		Seeding	Cutting	Shocking	Stacking	Stack threshing	Shock threshing	Total
			Hrs.	Times over	Hrs.	Times over	Hrs.	Times over	Hrs.	Times over	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs
36	26	1731	..	..	1.4	2.0	..	..	0.7	1.0	0.3	0.7	1.1	..	..	3.3	7.5
1	28	1219	2.4	1.0	0.5	1.0	0.4	0.5	0.5	2.0	0.5	1.0	1.5	..	..	2.1	8.9
20	30	1379	1.9	1.4	0.3	0.4	..	..	0.8	4.0	0.5	0.7	1.8	..	..	3.0	9.0
21	116	1321	0.6	0.5	0.4	0.7	0.1	0.3	0.6	1.2	0.5	0.8	1.4	..	..	4.9	9.3
29	44	1675	1.4	1.0	..	..	0.3	0.4	1.1	2.0	0.7	0.7	1.2	..	..	3.9	9.3
28	57	1369	1.6	0.8	..	..	0.9	1.5	0.7	2.0	0.7	0.7	2.0	..	..	2.7	9.3
24	48	1938	2.0	1.0	..	..	0.1	0.3	1.4	4.6	0.7	1.0	1.2	..	..	3.6	10.0
12	32	1784	1.2	1.0	..	..	0.3	0.7	0.8	2.0	1.1	0.9	1.5	..	..	4.4	10.2
27	33	1788	2.8	0.8	0.3	0.5	0.4	0.7	0.4	1.3	0.7	1.0	1.7	..	..	3.5	10.8
6	62	2541	2.7	0.7	0.5	0.7	1.2	1.9	0.7	2.4	0.6	1.0	1.4	..	..	2.9	11.0
18	59	1346	2.4	1.0	0.5	1.0	..	..	0.6	1.9	0.8	0.9	0.9	2.9	2.1	..	11.1
16	44	2126	2.7	1.0	..	..	0.2	0.6	0.8	2.0	0.7	0.7	2.4	..	..	3.9	11.4
14	36	1721	2.8	1.0	0.8	0.1	0.1	0.3	0.8	2.0	0.5	0.9	1.7	..	..	3.9	11.5
23	68	1159	1.7	1.0	..	..	..	..	0.7	2.8	0.9	0.7	1.2	4.7	1.7	..	11.6
31	39	1550	2.7	1.0	..	..	0.9	1.8	0.6	2.0	0.6	0.8	1.3	..	..	4.7	11.6
5	65	959	1.1	0.7	0.4	1.7	0.1	0.2	0.6	2.0	0.7	0.9	1.8	4.5	2.0	..	12.1
26	60	1769	2.0	1.0	0.3	0.6	0.2	0.3	1.2	5.3	0.7	0.8	2.0	3.3	1.9	..	12.4
10	49	1772	4.1	1.0	..	..	0.6	0.6	0.8	2.0	0.8	1.2	2.2	..	..	3.2	12.9
15	52	1898	1.9	0.8	..	..	3.7	5.6	0.6	1.9	0.6	0.8	2.2	..	..	3.7	13.5
9	71	1644	3.9	0.9	0.2	0.3	0.6	1.0	0.4	1.0	0.8	1.1	2.9	..	..	4.4	14.3
25	13	2892	2.9	1.0	0.5	1.0	..	..	0.8	2.2	1.0	0.9	3.5	..	..	5.3	14.9
35	34	1308	2.9	1.1	0.5	1.0	0.4	0.7	1.2	3.2	1.0	0.9	1.8	..	..	6.3	15.0
Averages																	
22 farms,	1922	48	1578	2.2	0.9	0.2	0.5	0.5	0.8	0.7	1.1	0.7	0.9	1.7	(3.8)	(1.9)	3.9	10.8†
23 "	1920	51	1133	2.2	1.0	0.1	0.2	*	*	0.9	3.8	0.7	0.9	1.1	(5.1)	(1.6)	3.4	9.6
21 "	1921	53	1197	2.0	1.0	0.6	1.0	0.5	1.0	0.4	1.4	0.7	1.0	1.6	..	..	3.3	10.1
22 "	1923	48	1662	1.8	0.7	0.2	0.4	0.2	0.5	0.5	1.8	0.7	0.9	1.4	(3.2)	(2.1)	3.5	9.2
23 "	1924	46	1984	1.9	0.8	0.2	0.7	0.3	0.5	0.6	1.9	0.7	0.9	2.2	(7.0)	(2.7)	3.9	10.7

* Included with disking.

† Totals are for shock-threshed grain.

TABLE XLVI

HORSE AND TRACTOR WORK USED PER ACRE, BY OPERATIONS, FOR SMALL GRAIN, 1922

Farm No.	Acres per farm	Yield lbs.	Plowing			Disking			Spring-tooth harrowing		
			Horse hrs.	Tractor hrs.	Times over	Horse hrs.	Tractor hrs.	Times over	Horse hrs.	Tractor hrs.	Times over
36	26	1731	..	..	..	5.1	..	2.0	..	..	.
1	28	1219	9.2	..	1.0	1.9	..	1.0	1.5	..	0.5
20	30	1379	12.4	..	1.4	1.1	..	0.4	..	..	..
21	116	1321	..	0.6	0.5	..	0.4	0.7	..	0.1	0.3
29	44	1675	..	1.4	1.0	..	..	..	0.8	0.1	0.4
28	57	1369	2.7	0.9	0.8	..	..	..	2.2	0.4	1.5
24	48	1938	3.3	1.1	1.0	..	..	..	..	0.1	0.3
12	32	1784	..	1.2	1.0	..	..	..	1.4	..	0.7
27	33	1788	8.3	..	0.8	1.2	..	0.5	1.7	..	0.7
6	62	2541	7.8	..	0.7	1.6	..	0.7	4.5	..	1.9
18	59	1346	8.9	..	1.0	1.9	..	1.0	..	..	..
16	44	2126	9.2	..	1.0	..	..	..	0.6	..	0.6
14	36	1721	11.1	..	1.0	0.3	..	0.1	0.5	..	0.3
23	68	1159	3.1	0.9	1.0	..	..	..	..	..	..
31	39	1550	7.9	0.6	1.0	..	..	..	2.3	0.3	1.8
5	65	959	0.9	0.8	0.7	..	0.4	1.7	0.4	..	0.2
26	60	1769	12.0	..	1.0	1.3	..	0.6	0.9	..	0.3
10	49	1772	12.1	..	1.0	..	..	..	2.1	..	0.6
15	52	1898	3.5	0.7	0.8	..	..	..	1.5	..	5.6
9	71	1644	11.5	..	0.9	1.0	..	0.3	2.4	..	1.0
25	13	2892	11.6	..	1.0	2.1	..	1.0	..	..	..
35	34	1308	8.7	0.7	1.1	1.4	..	1.0	..	0.4	0.7
Averages											
22 farms, 1922..... 48		1578	6.0	0.4	0.9	0.6	0.1	0.5	1.1	0.1	0.8
23 " 1920..... 51		1133	4.2	1.0	1.0	0.2	..	0.2	*	*	*
21 " 1921..... 53		1197	4.2	0.9	1.0	1.2	0.2	1.0	1.6	0.2	1.0
22 " 1923..... 48		1662	6.1	0.2	0.7	0.9	..	0.4	1.0	..	0.5
23 " 1924..... 46		1984	6.5	0.2	0.8	0.5	0.1	0.7	1.1	..	0.5

* Included with disking.

TABLE XLVI —*Continued*

Farm No	Acres per farm	Yield lbs.	Harrowing			Seeding hrs.	Cutting		Stacking hrs.	Stack threshing hrs.	Shock threshing hrs.	Total	
			Horse hrs.	Tractor hrs.	Times over		Horse hrs.	Tractor hrs.				Horse hrs.	Tractor hrs.
36	26	1731	1.3	..	1.0	0.5	3.0	..	..	..	3.3	13.2	..
1	28	1219	2.0	..	2.0	2.1	3.9	..	..	..	3.1	23.7	..
20	30	1379	3.1	..	4.0	2.1	2.6	..	..	..	5.2	26.5	..
21	116	1321	1.7	0.04	1.2	2.2	..	0.4	..	..	5.9	9.8	1.5
29	44	1675	4.3	..	2.0	2.8	2.8	..	..	..	5.0	15.7	1.5
28	57	1369	2.9	..	2.0	2.7	2.9	..	..	..	3.8	17.2	1.3
24	48	1938	4.9	..	4.6	2.9	3.9	..	..	..	4.6	19.6	1.2
12	32	1784	3.0	..	2.0	3.6	3.5	..	..	..	6.6	18.1	1.2
27	33	1788	1.5	..	1.3	2.1	3.8	..	..	..	4.7	23.3	..
6	62	2541	1.7	..	2.4	1.7	3.5	..	..	..	5.1	25.9	..
18	59	1346	2.3	..	1.9	3.1	3.4	..	3.9	0.7	..	24.2	..
16	44	2126	3.2	..	2.0	2.0	2.7	..	..	..	5.6	23.3	..
14	36	1721	3.3	..	2.0	2.1	3.5	..	..	..	5.8	26.6	..
23	68	1159	2.9	..	2.8	1.8	2.8	..	6.2	0.5	..	17.3	0.9
31	39	1550	2.2	0.04	2.0	2.4	2.5	..	..	..	5.9	23.2	0.9
5	65	959	2.4	..	2.0	2.9	3.6	..	5.5	0.4	..	16.1	1.2
26	60	1769	4.3	..	5.3	2.6	3.2	..	4.8	1.2	..	30.9	..
10	49	1772	3.2	..	2.0	1.6	3.6	..	..	..	4.5	27.1	..
15	52	1898	2.2	..	1.9	1.8	3.3	..	..	..	4.4	16.7	0.7
9	71	1644	1.5	..	1.0	3.0	4.3	..	..	..	6.7	30.4	..
25	13	2892	2.8	..	2.2	2.4	3.7	..	..	..	7.6	30.2	..
35	34	1308	3.9	0.1	2.2	2.9	3.4	..	..	..	7.0	27.3	1.2
Averages													
22 farms, 1922.....	48	1578	2.7	..	2.2	2.4	3.0	..	(5.1)	(0.7)	5.3	21.1†	0.6†
23 " 1920	51	1133	2.6	0.1	3.8	2.4	2.7	0.1	(5.5)	(0.4)	4.3	16.4	1.2
21 " 1921.....	53	1197	1.6	..	1.4	2.3	2.5	0.2	..	..	5.0	18.4	1.5
22 " 1923.....	48	1662	1.9	..	1.8	2.3	2.6	0.1	(4.4)	(0.4)	5.3	20.1	0.8
23 " 1924.....	46	1984	2.2	..	1.9	2.4	3.0	0.1	(4.7)	(1.8)	6.3	22.0	1.0

† Totals are for shock-threshed grain.

TABLE XLVII

MAN LABOR USED PER ACRE, BY OPERATIONS, FOR TAME HAY, 1922

Farm No.	Acres per farm	Yield tons	Percentage cut twice	Mowing hrs.	Raking hrs.	Hauling and stacking hrs.	Total hrs.
10	16	1.2	..	1.1	0.4	2.6	4.1
27	12	3.3	..	1.0	0.6	3.1	4.7
24	23	1.4	..	1.2	0.5	3.4	5.1
31	20	1.3	..	0.7	0.6	3.8	5.1
26	45	2.1	*	1.0	0.4	3.7	5.1
21	19	2.2	*	1.0	0.7	3.5	5.2
29	16	1.3	..	1.0	0.7	3.9	5.6
28	23	1.5	26	1.7	0.8	3.8	6.3
6	43	1.3	..	1.1	0.3	5.2	6.6
35	9	1.9	..	1.1	0.4	5.5	7.0
20	22	1.7	*	1.5	0.7	4.9	7.1
14	9	2.6	100	1.9	1.3	4.4	7.6
18	7	2.0	..	1.0	0.8	6.2	8.0
1	14	1.7	100	2.2	1.0	5.4	8.6
25	22	1.9	..	2.0	1.0	6.0	9.0
15	31	1.9	..	1.1	0.4	8.1	9.6
16	31	2.0	60	1.6	0.7	7.6	9.9
12	9	2.4	65	1.7	0.6	7.8	10.1
5	18	1.1	..	1.1	1.0	9.0	11.1
Averages							
19 farms, 1922	21	1.7	14	1.3	0.6	5.2	7.1
22 " 1920	18	1.8	49	1.7	0.8	7.3	9.8
19 " 1921	21	1.4	27	1.5	0.7	6.2	8.4
20 " 1923	20	1.1	11	1.2	0.6	4.1	5.9
19 " 1924	17	1.5	32	1.4	0.7	4.8	6.9

* Second crop cut for seed; labor not included here.

TABLE XLVIII

HORSE WORK USED PER ACRE, BY OPERATIONS, FOR TAME HAY, 1922

Farm No.	Acres per farm	Yield tons	Percentage cut twice	Mowing hrs.	Raking hrs.	Hauling and stacking hrs.	Total hrs.
10	16	1.2	..	2.2	0.8	4.8	7.8
27	12	3.3	..	2.0	1.2	7.4	10.6
24	23	1.4	..	2.4	1.0	5.4	8.8
31	20	1.3	..	1.4	1.2	7.5	10.1
26	45	2.1	*	2.0	0.8	7.4	10.2
21	19	2.2	*	2.0	1.4	3.7	7.1
29	26	1.3	..	2.0	1.4	6.5	9.9
28	23	1.5	26	3.4	1.6	5.4	10.4
6	43	1.3	..	2.2	0.6	7.0	9.8
35	9	1.9	..	2.2	0.8	12.9	15.9
20	22	1.7	*	3.0	1.4	7.3	11.7
14	9	2.6	100	3.8	2.6	7.8	14.2
18	7	2.0	..	2.0	1.6	12.3	15.9
1	14	1.7	100	4.4	2.0	10.5	16.5
25	22	1.9	..	4.0	2.0	5.8	11.8
15	31	1.9	..	2.2	0.8	11.7	14.7
16	31	2.0	60	3.2	1.4	8.2	12.8
12	9	2.4	65	3.4	1.2	11.2	15.8
5	18	1.1	..	2.2	2.0	11.0	15.2
Averages							
19 farms, 1922	21	1.7	14	2.6	1.2	7.7	11.5
22 " 1920	18	1.8	49	3.4	1.6	9.0	14.0
19 " 1921	21	1.4	27	3.0	1.4	8.7	13.1
20 " 1923	20	1.1	11	2.4	1.2	5.8	9.4
19 " 1924	17	1.5	32	2.8	1.4	7.7	11.9

* Second crop cut for seed; labor not included here.

TABLE XLIX

MAN LABOR USED PER ACRE, BY OPERATIONS, FOR ALFALFA, 1922

Farm No.	Acres per farm	Yield tons	Mowing hrs.	Raking hrs.	Tedding, turning, cocking, hrs.	Hauling and stacking hrs.	Total hrs.
First cutting							
16	3	2.1	0.9	0.6	1.2	2.7	5.4
1	5	1.6	1.2	0.4	..	4.2	5.8
31	4	1.6	1.1	0.8	..	4.4	6.3
14	5	1.2	1.4	1.0	..	5.2	7.6
9	11	2.1	1.1	0.6	..	6.6	8.3
12	9	2.5	0.9	0.7	..	6.7	8.3
21	4	1.4	1.1	0.7	0.6	6.1	8.5
15	2	2.6	1.0	0.5	2.6	5.1	9.2
35	7	1.3	1.0	0.7	1.0	6.6	9.3
20	4	2.0	1.0	0.5	..	7.9	9.4
27	4	3.1	1.4	1.4	3.6	5.0	11.4
36	3	2.6	1.8	1.1	8.5	8.1	19.5
12 farms, 1922	5	2.0	1.1	0.7	0.9	6.0	8.7
3 " 1920	2	3.0*	1.5	1.0	3.9	6.2	12.6
6 " 1921	5	1.7	1.3	0.6	0.6	6.6	9.1
16 " 1923	6	1.1	1.1	0.5	0.6	3.8	6.0
20 " 1924	8	1.2	1.2	0.6	0.6	4.8	7.2
Second cutting							
16	3	1.2	0.9	0.5	..	1.2	2.6
35	7	1.0	1.2	0.3	0.3	2.8	4.6
21	4	0.8	1.1	0.8	..	3.3	5.2
1	5	1.1	1.2	0.4	..	3.6	5.2
14	5	0.6	1.0	2.0	..	2.3	5.3
36	3	1.1	1.5	0.4	1.1	2.6	5.6
31	4	1.1	1.1	0.8	..	3.8	5.7
27	4	1.4	1.0	0.5	2.2	2.4	6.1
12	9	1.2	1.0	0.4	..	4.8	6.2
20	4	1.2	1.0	1.0	..	4.7	6.7
9	11	1.6	1.3	0.3	..	5.6	7.2
15	2	1.5	1.3	0.5	4.1	7.7	13.6
Averages							
12 farms, 1922	5	1.2	1.1	0.6	0.4	3.9	6.0
3 " 1920	2	*	1.8	0.7	0.5	4.3	7.3
6 " 1921	5	1.3	1.2	0.6	0.5	5.0	7.3
16 " 1923	6	1.2	1.1	0.5	0.2	3.3	5.1
20 " 1924	7	1.1	1.3	0.6	0.7	3.9	6.5
Third cutting							
31	3	0.5	0.7	0.3	..	2.0	3.0
35	7	0.9	0.9	0.6	..	2.1	3.6
16	3	0.6	0.9	0.5	..	2.4	3.8
36	3	0.4	0.7	0.7	0.7	1.8	3.9
14	3	0.7	1.1	0.1	..	2.8	4.0
20	4	0.7	1.2	0.5	..	2.5	4.2
9	11	1.2	1.4	1.0	..	4.0	6.4
12	9	1.4	1.0	0.3	..	5.9	7.2
1	5	0.7	0.9	0.7	3.4	3.1	8.1
Averages							
9 farms, 1922	5	1.0	1.0	0.7	0.3	3.5	5.5
2 " 1920	3	*	1.9	0.3	0.2	2.0	4.4
5 " 1921	6	0.7	1.2	0.9	0.9	4.6	7.6
9 " 1923	7	0.5	1.3	0.6	0.1	2.3	4.3
16 " 1924	7	0.7	1.2	0.5	0.2	2.1	4.0

* Entire yield reported for first cutting.

TABLE L

HORSE WORK USED PER ACRE, BY OPERATIONS, FOR ALFALFA, 1922

Farm No.	Acres per farm	Yield tons	Mowing hrs.	Raking hrs.	Tedding, turning, cocking, hrs.	Hauling and stacking hrs.	Total hrs.
First cutting							
16	3	2.1	1.8	1.2	1.2	1.8	6.0
1	5	1.6	2.4	0.8	..	8.4	11.6
31	4	1.6	2.2	1.6	..	5.4	9.2
14	5	1.2	2.8	2.0	..	6.2	11.0
9	11	2.1	2.2	1.2	..	8.9	12.3
12	9	2.5	1.8	1.4	..	9.1	12.3
21	4	1.4	2.2	1.4	1.1	5.0	9.7
15	2	2.6	2.0	1.0	..	5.1	8.1
35	7	1.3	2.0	1.4	..	10.1	13.5
20	4	2.0	2.0	1.0	..	5.4	8.4
27	4	3.1	2.8	2.8	..	9.1	14.7
36	3	2.6	3.6	2.2	..	13.2	19.0
Averages							
12 farms, 1922	5	2.0	2.2	1.4	0.1	7.8	11.5
3 " 1920	2	3.0*	3.0	2.0	0.6	7.2	12.8
6 " 1921	5	1.7	2.6	1.2	0.3	7.2	11.3
16 " 1923	6	1.1	2.2	1.0	0.1	5.1	8.4
20 " 1924	8	1.2	2.4	1.2	0.2	7.0	10.8
Second cutting							
16	3	1.2	1.8	1.0	..	1.2	4.0
35	7	1.0	2.4	0.6	..	4.5	7.5
21	4	0.8	2.2	1.6	..	2.8	6.6
1	5	1.1	2.4	0.8	..	6.2	9.4
14	5	0.6	2.0	4.0	..	2.9	8.9
36	3	1.1	3.0	0.8	..	5.1	8.9
31	4	1.1	2.2	1.6	..	7.5	11.3
27	4	1.4	2.0	1.0	..	4.8	7.8
12	9	1.2	2.0	0.8	..	9.1	11.9
20	4	1.2	2.0	2.0	..	7.9	11.9
9	11	1.6	2.6	0.6	..	8.4	11.6
15	2	1.5	2.6	1.0	..	5.1	8.7
Averages							
12 farms, 1922	5	1.2	2.2	1.2	..	6.1	9.5
3 " 1920	2	*	3.6	1.4	0.1	5.8	10.9
6 " 1921	5	1.3	2.4	1.2	..	5.8	9.4
16 " 1923	6	1.2	2.2	1.0	..	4.3	7.5
20 " 1924	7	1.1	2.6	1.2	0.3	5.3	9.4
Third cutting							
31	3	0.5	1.4	0.6	..	2.0	4.0
35	7	0.9	1.8	1.2	..	2.7	5.7
16	3	0.6	1.8	1.0	..	1.8	4.6
36	3	0.4	1.4	1.4	..	3.6	6.4
14	3	0.7	2.2	0.2	..	5.6	8.0
20	4	0.7	2.4	1.0	..	3.4	6.8
9	11	1.2	2.8	2.0	..	5.6	10.4
12	9	1.4	2.0	0.6	..	7.8	10.4
1	5	0.7	1.8	1.4	..	6.2	9.4
Averages							
9 farms, 1922	5	1.0	2.0	1.4	..	4.9	8.3
2 " 1920	3	*	3.8	0.6	..	3.7	8.1
5 " 1921	6	0.7	2.4	1.8	0.3	6.0	10.5
9 " 1923	7	0.5	2.6	1.2	..	3.2	7.0
16 " 1924	7	0.7	2.4	1.0	0.2	3.1	6.7

* Entire yield reported for first cutting.

TABLE LI

MAN LABOR USED PER ACRE, BY OPERATIONS, FOR WILD HAY, 1922

Farm No.	Acres per farm	Yield tons	Mowing hrs.	Raking hrs.	Hauling and stacking hrs.	Total hrs.
14	12	1.6	1.2	0.8	2.8	4.8
20	3	1.1	1.4	0.7	3.2	5.3
18	13	2.0	1.4	0.5	3.8	5.7
35	4	1.1	1.6	0.7	4.1	6.4
23	25	1.8	1.3	0.5	4.6	6.4
27	6	1.4	1.1	0.6	5.5	7.2
36	4	1.0	1.9	0.5	5.6	8.0
5	24	1.1	0.8	0.7	6.6	8.1
21	22	2.6	1.6	0.7	6.2	8.5
9	10	1.2	1.4	0.7	6.5	8.6
15	9	1.8	0.9	0.7	7.1	8.7
12	3	1.1	1.1	0.4	7.6	9.1
Averages						
12 farms, 1922	11	1.5	1.3	0.6	5.3	7.2
14 " 1920	14	1.1	1.3	0.6	4.8	6.7
13 " 1921	13	0.7	1.3	0.5	4.8	6.6
9 " 1923	14	0.6	1.3	0.6	2.4	4.3
8 " 1924	16	0.9	1.2	0.5	2.2	3.9

TABLE LII

HORSE WORK USED PER ACRE, BY OPERATIONS, FOR WILD HAY, 1922

Farm No.	Acres per farm	Yield tons	Mowing hrs.	Raking hrs.	Hauling and stacking hrs.	Total hrs.
14	12	1.6	2.4	1.6	4.0	8.0
20	3	1.1	2.8	1.4	4.6	8.8
18	14	2.0	2.8	1.0	7.6	11.4
35	4	1.1	3.2	1.4	6.4	11.0
23	25	1.8	2.6	1.0	8.8	12.4
27	6	1.4	2.2	1.2	11.0	14.4
36	4	1.0	3.8	1.0	11.1	15.9
5	24	1.1	1.6	1.4	8.1	11.1
21	22	2.6	3.2	1.4	6.9	11.5
9	10	1.2	2.8	1.4	6.6	10.8
15	9	1.8	1.8	1.4	10.3	13.5
12	3	1.1	2.2	0.8	11.4	14.4
Averages						
12 farms, 1922	11	1.5	2.6	1.2	7.6	11.4
14 " 1920	14	1.1	2.6	1.2	5.9	9.7
13 " 1921	13	0.7	2.6	1.0	6.9	10.5
9 " 1923	14	0.6	2.6	1.2	3.4	7.2
8 " 1924	16	0.9	2.4	1.0	3.5	6.9